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Volume 5

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Among Our Writers

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GEORGE PERRINE received the degree of civil engineer from Columbia University School of Mines in 1894. He has had wide experience in various branches of civil engineering, ranging from aqueduct and steamship pier construction to building and industrial plant valuation, with perhaps greatest emphasis on subway and tunnel construction, principally as field engineer for contractors.

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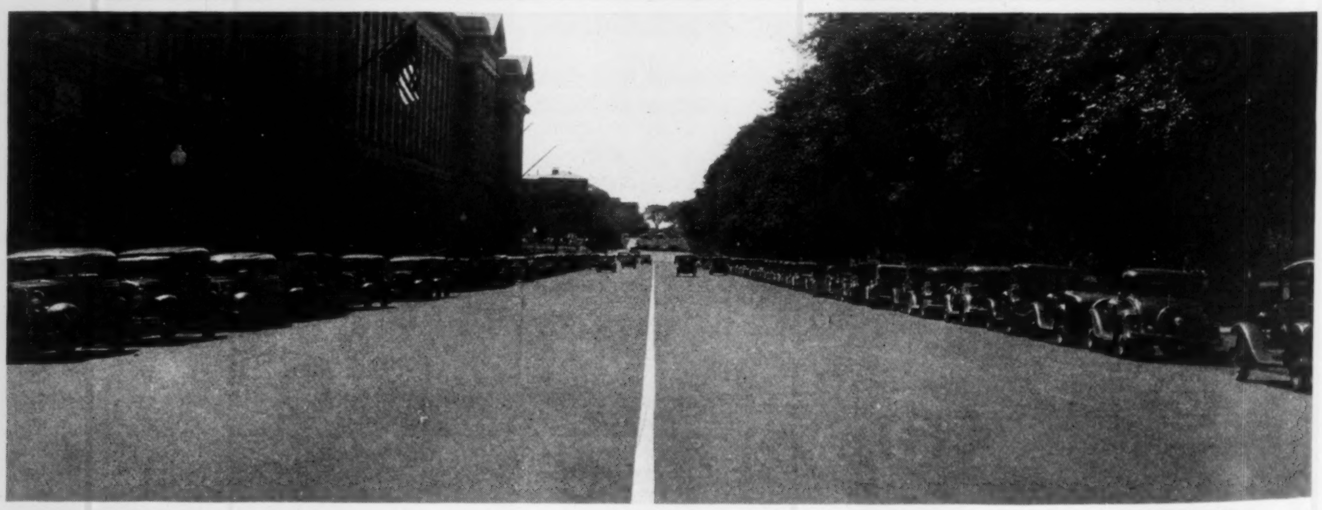

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Earthquake Effects on Elevated Water Tanks

Model Studies Throw Needed Light on a Complicated Problem

By Arthur C. Ruge
Research Associate in Seismology, Department of Civil and Sanitary Engineering,
Massachusetts Institute of Technology, Cambridge, Mass.

Too few data have been available in the past on the vibrations in structures due to seismic movements. In attempting to design a quake-proof structure without such detailed knowledge, the question of how much rigidity to provide is a vexing one, since the stresses resulting from quakes are a function of the structure's dynamic nature as well as of the acceleration produced by movements of its base. Mr. Ruge here combines an analysis of the basic problem with the results of a noteworthy study made by the use of a model. This article was prepared from a paper presented by the author on December 20, 1934, before the Providence Section of the Society.

Earthquake study, or seismology, did not emerge as a science until late in the nineteenth century, when a group of English scientists were brought to Japan by the Japanese Government to introduce occidental educational methods. These men soon became interested in the earthquakes that occurred so frequently there and it is from their researches that the modern science of seismology has developed.

Considering the newness of this science, it is small wonder that the engineering problems of earthquake-proof construction are still largely unsolved. Little could be done until the nature and causes of earthquakes were understood. How does the ground actually move during an earthquake and at what speed? These things the engineer must know if he is to apply scientific methods to the design of a structure to withstand the shaking. Such information is gradually being collected and will be of great value in the future.

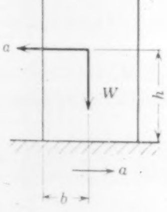


Fig. 1. A Block Provides a Crude Means of Measuring Ground Motion

Before discussing modern concepts of the effect of earthquakes on structures, it may be well to trace the history and development of the commonly-used simple method of quake-proof design. It undoubtedly originated with that earnest English group of founders of modern seismology in the last century, as a natural and logical result of their diligent efforts to reduce the science to a quantitative basis. They recognized that the overturning of monuments and other rigid, block-like objects provided a ready means of making crude but valuable estimates of the intensity and direction of the ground motion in destructive earthquakes. At that time suitable instruments had not yet been invented, and tombstones and monuments were plentiful in Japan. The principle was simple: The ground (Fig. 1) moves with an acceleration a and the block, being rigid, is forced to move with it until the inertia force, $\frac{W}{g}a$, becomes large enough to overcome the stabilizing force, W; that is, when $\frac{W}{g}ah$ equals Wb, at which time overturning begins. Here W is the weight of the block and g is the acceleration due to gravity. Thus acceleration necessary to overturn a given stone was calculated by the simple formula, $a = \frac{b}{h}g$.

This concept soon led to the classification of earthquake intensity and earthquake damage almost entirely according to ground accelerations, an unfortunate heritage of the past which is still very much in evidence. As far back as 1875, Milne recognized the fact that the "falling column" method of determining earthquake intensity is quite unreliable. If the ground maintained a constant acceleration in one direction the formula would be correct, but actually the ground reverses its motion from time to time, making it possible for the block to teeter back and forth in such a way that it will overturn at accelerations much greater or much less than the formula would indicate. Not only this, but the presence of any vertical motion will affect the results.

The first attempts to rationalize the design of earthquake-resistant structures naturally made use of this principle in reverse; that is, given the maximum acceleration believed to exist in an actual destructive quake, it was only necessary to apply forces to the structure equal to the product of its several masses and this acceleration, and treat the problem as one of simple statics. If the structure proved stable and not overstressed, it would be considered safe. In fairness to the pioneers who developed this method, it should be said that they were content to apply it only to rigid structures, such as stiff masonry walls, low buildings, and the like, where it may give satisfactory results.

It is easy to see how so simple a principle is apt to be carried too far. Indeed, it is difficult to say just where it ceases to be of value. Fortunately, however, it can be demonstrated that elevated tank structures, of which I shall speak in particular, are so far removed from the border line that this simple design rule fails to apply even very crudely—that is, "fortunately" in the sense that it is well to know definitely what the problem is even if the ideal solution is not yet at hand.

Let us consider the nature of a typical elevated tank structure. Essentially there is a large concentrated mass—made up of the tank shell, water, platform, and girder—at the top of a tall, slender, and relatively light-weight tower. For all practical purposes in this discussion the tower can be considered as a weightless elastic member which, in addition to supporting the weight of the tank and contents, provides resistance or stiffness against lateral forces.

But there is one important way in which this structure differs in behavior from the rigid block in Fig. 1: When lateral forces are applied at the tank, deflections occur. As a result, when the ground moves in an earthquake, the tank and contents are not forced to move exactly as does the base, but the flexibility of the tower allows the mass at the top to vibrate to and fro. If the motions of the ground happen to coincide more or less with the natural vibrations of the structure, these vibrations may become very large and the structure may fail or become overstressed, depending only upon the amplitude of the ground motions and their duration. It can hardly be overemphasized that under such conditions the stresses set up in the tower may easily be several times as large as those calculated by the simple assumption that the maximum force acting on the tank and contents is merely the product of the mass and the maximum ground acceleration. Also it is important to recognize the fact that the earthquake periods need not be "in resonance" with the natural vibration period of the structure in order to produce this effect to a marked degree.

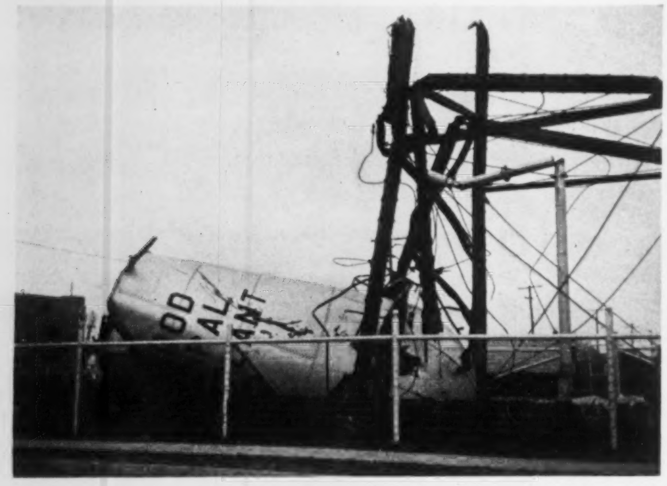


Fig. 2. A Typical Tank Failure
Occurring in California in 1933.

A typical elevated tank failure in the Long Beach earthquake of 1933 is shown in Fig. 2. Such a failure must be attributed largely to the dynamic action of the quake rather than to the weakness of the tank against lateral forces statically applied.

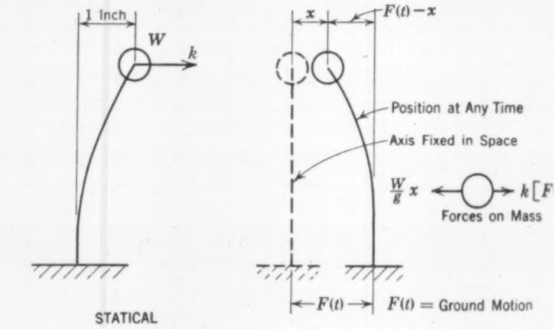
Assuming for the moment that a water tank on a tower can be considered as a simple inverted pendulum (as if the water were frozen solid), an equation can be set up which will express the effect of an earthquake motion applied to its base (Fig. 3). The equation for the dynamic equilibrium of W is obtained by considering the sum of all the forces acting on the mass as equal to zero (by d'Alembert's principle). The equation is therefore $\frac{W}{g} x'' + kx = kF(t)$ in which x and x'' define respectively the absolute displacement and the acceleration of W.

Now the solution to this equation is made up of two vibrations: one, that natural to the pendulum, and the other of the same form as $F(t)$. The first part is called the "transient" vibration, because it will die out in time as a result of friction. The second part is called the "forced" vibration or the "steady state" vibration, because it will continue as long as $F(t)$ continues. It is possible to solve this equation for very irregular types of base motions, although it is a tedious process even for such a simple system as this.

In Fig. 4 is shown the nature of the vibrations of an inverted pendulum which is subjected to a simple back-and-forth base motion (of cosine form) starting from a state of rest. The maximum deflections are given for various time intervals in order to show the growth of the vibration. For comparison, the steady state response is also plotted. The part played by the transients is clearly seen here. As the vibration continues, the transients die away due to friction, and the motion gradually goes into the steady state. Simply stated, the transients bridge the physical discontinuity between the ultimate steady vibration and the state of rest at the start. It is also of importance to observe that the deflections due to the transients are rather large, which shows the necessity for taking them into account in studies of earthquake stress.

If the case of a tower-tank filled with water is now considered, it will be seen immediately that the dynamic problem is not at all simple. So far as I am aware, no analytical solution including the transient vibrations has ever been developed. Such a system has two fundamental degrees of freedom and hence two fundamental periods at which it can vibrate naturally.

The lowest, or slowest, mode of vibration consists principally of a swinging motion of the water within the tank. A slight movement of the tower accompanies this mode. The second and only important mode in most tank structures consists of a swaying back and forth of the tank as a whole, while a large part of the water moves with the tank. This mode resembles the action of a simple inverted pendulum. There are other modes possible to the system but they are not important from the standpoint of earthquake resistance. The presence of water as part of a vibrating system brings about nonlinearity in dynamic behavior; that is, the effect will not be directly proportional to the cause.



STATICAL CHARACTERISTICS

PENDULUM IN MOTION

Fig. 3. A Simple Inverted Pendulum Subjected to Earthquake Motion at Its Base

With such a system it will readily be seen that analytical solutions are quite out of the question, in view of the labor involved and of the doubtful assumptions that would have to be made in order to obtain any solution at all. The only alternative is to make tests on models, or on full-sized structures if feasible.

In problems of this nature, the model method offers marvelous possibilities. In the engineering sense, a model is a special calculating machine for working out complicated problems or, in other cases, for obtaining a large number of solutions to a simple but tedious problem. A model does not necessarily look like its prototype, and it need not be a simple scale reproduction at all. The criterion is merely that the investigator must be able to deduce the behavior of the prototype under the influence of certain forces and motions from the behavior of the model when it is subjected to similar and properly proportioned forces and motions. Neither does the relation between the two need to be simple. Moreover, a model need not reproduce all features of its prototype, but merely those which the experimenter desires to study. For example, a model of a light cantilever beam with a weight on the end can be made by using a simple spring in place of the cantilever. Now this model is perfectly suited for the study of both free and forced vibrations of the weight as regards displacement, velocities, accelerations, and frequency, but nothing can be learned from it directly about the end reactions or the stresses set up in the prototype. Yet no one would hesitate to accept the results of the model, as far as they are true reproductions of prototype features.

Such artifices are and must be used in all model studies, except in the very simplest cases. Thus, duplication of the breaking or ultimate strength of the prototype is not usually attempted, because the engineer is not interested in stressing the structure beyond reasonable working limits. But at the same time, it is necessary to know how far one can safely go in the simplifying process without sacrificing the required accuracy. When can a distributed mass be treated as a discrete mass and when not? When is it proper to disregard viscous forces in the model of a water tank? Such questions cannot be passed over lightly if model study of earthquake effects is to be developed into a quantitative art.

The model relations for a water tank and tower are easily determined. For the moment it will be assumed that the weight of the tower is negligible as compared with the mass of the tank and water. First the effect of reducing the scale of the water system alone will be examined—obviously it must be scaled down geometrically if there is to be three-dimensional similarity between model and prototype. Consider an element of water, viscous forces neglected. Forces of two types are observed—gravity or weight forces, and inertia forces.

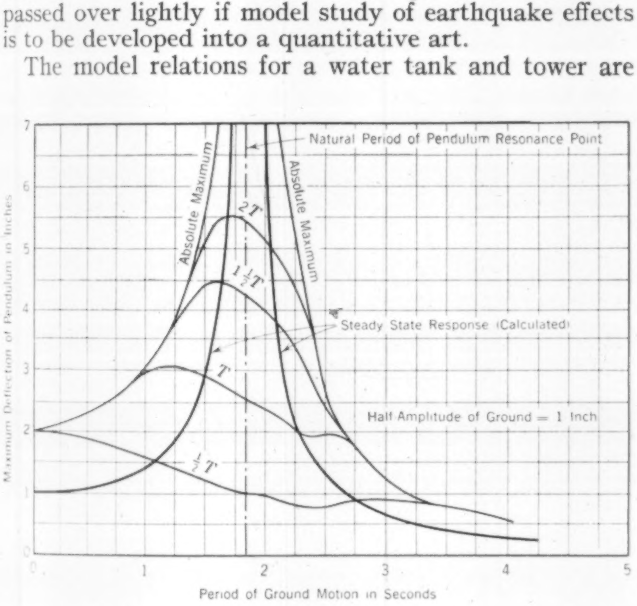


Fig. 4. Nature of Vibrations of Inverted Pendulum Showing Maximum Deflections Due to Both Transient and Forced or Steady State Vibrations

Let ρ = density of fluid in prototype
L = linear dimension in prototype
M = mass in prototype
T = time in prototype
g = acceleration due to gravity

The first force, that of gravity or weight, may be expressed as

$$F(\text{weight}) = Mg = \rho L^3 g, \text{ dimensionally} \quad . \quad . \quad . \quad . \quad [1]$$

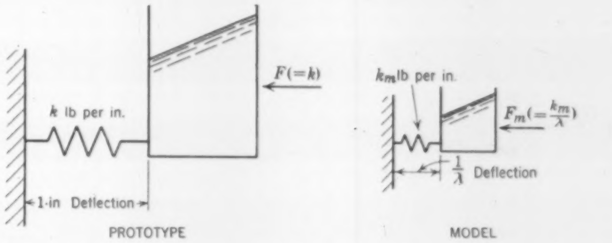


Fig. 5. Necessary Relations Between a Model and Its Prototype

The second, that of inertia, may be expressed as

$$F\text{ (Inertia force)} = Ma = M\frac{L}{T^2} = \frac{\rho L^4}{T^2}, \text{ dimensionally} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad [2]$$

From Equation 1 comes the relation,

$$\frac{F}{F_m} = \frac{\rho}{\rho_m}\lambda^3\frac{g}{g_m} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad [3]$$

and from Equation 2,

$$\frac{F}{F_m} = \frac{\rho}{\rho_m}\lambda^4 t^{-2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad [4]$$

in which the subscript m refers to corresponding quantities in the model; λ is the scale of length used in building the model; and t is the scale of time—for instance, it is the ratio of the time required for an oscillation to occur in the prototype to that required for the corresponding oscillation to occur in the model.

Since the element of water is subjected to both kinds of force, it is obvious that if there is to be dynamic similarity between model and prototype both kinds of force must be maintained in the same relation. That is, the following must be true:

$$\frac{\rho}{\rho_m}\lambda^3\frac{g}{g_m} = \frac{\rho}{\rho_m}\lambda^4 t^{-2}$$

whence comes the familiar relation, $t = \sqrt{\lambda}$, since $\frac{g}{g_m}$ here equals 1. This shows that the time-scale is independent of the density of the liquid, as would be expected. The simple gravity pendulum is illustrative of this fact. Taking $T = 2\pi\sqrt{\frac{l}{g}}$, $\frac{T}{T_m} = t = \sqrt{\lambda}$, for $g = g_m$. The bob weight does not appear.

From this analysis it can be seen that the water in a tank model resting on the ground (when modeled to geometrical scale) will perfectly reproduce to scale the action of the prototype. Of course if we choose to let the ground beneath the model move, the amplitudes and periods of the ground motions for the model must be scaled down according to λ and t, respectively.

Next to be considered is the effect of scale upon the elastic part of the system, that is, the tower. For simplicity, imagine the tower replaced by a spring of equivalent stiffness, k lb per in. In Fig. 5 are shown the relations that must exist between model and prototype.

The deflections are fixed by the λ-scale on account of the similarity relations in the gravity system (the water). The *k* relations are now to be determined. From the sketch, Fig. 5,

$$\frac{k}{k_m} = \frac{F}{\lambda F_m}$$

but it has already been found that $\frac{F}{F_m} = \frac{\rho}{\rho_m}\lambda^3$, and it is obvious that there can be only one force scale for true similarity.

Therefore $\frac{k}{k_m} = \frac{\rho}{\rho_m}\lambda^2$ is obtained, and here the density of the liquid does not drop out of the equation. If this *k*-scale is maintained, all the acting forces are reduced in exactly the same ratio, and hence perfect similarity results. It is important to observe that a geometrically scaled model of the tower would not give dynamic similarity unless it were built of a material having a modulus of elasticity of $\frac{\rho_m}{\rho\lambda}$ times that of steel, a condition difficult to satisfy in a small model. Thus, in any event some deviation from geometrical scaling is necessary. The elasticity of the tank shell is of minor importance.

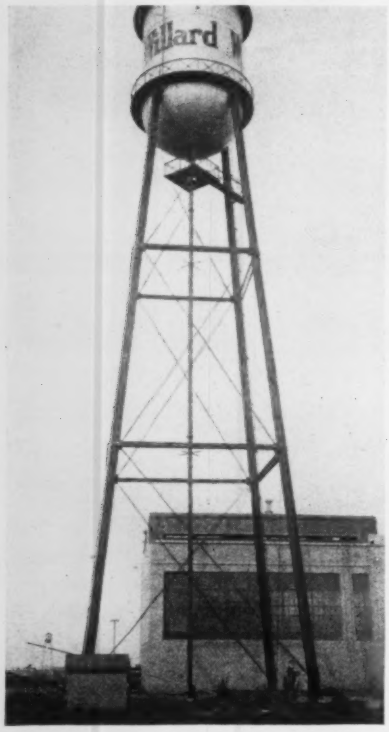


FIG. 6. PROTOTYPE OF MODEL STUDY
A 60,000-Gal Tank on a 100-Ft Tower

The only remaining features to be taken care of are the weights of the shell and tower. The weight of the former is reduced in the same relation as the fluid weight, and if the model shell is too light, a small extra weight is attached. As to the tower, it may be shown that an equivalent weight can be added at the tank to make up for any difference from theoretical similarity for the two important modes of vibration. The procedure is somewhat too long to give here. In any event, the weight of the tower is small compared to the total weight and it may even be neglected with very little error. In this particular research it was provided for properly. Other special features, such as the so-called "gravity effect," had to be taken into account but offered no difficulty. Several tests were made using a glycerine solution in the tank instead of water to determine the effect of viscosity. This proved to be negligible.

The prototype used as a basis for the study was a 60,000-gal tank on a 100-ft tower, illustrated in Fig. 6. The model used in the laboratory built on a scale of 46 to 1 is illustrated in Fig. 7. It will be seen that the study was limited to motion in one direction only, owing to the symmetry of a standard tower design. Flat steel bars were used to give the necessary stiffness to the tower. The arrangement for adjusting the stiffness to the correct value is clearly shown in the figure. Had actual rods and columns been used for the model of the tower, it would have been extremely difficult to obtain accuracy on such a small scale. The adjustable bar tower was easy to adjust to within $^1/_2$ per cent accuracy and had the added advantage of being capable of withstanding considerable motion, so that it could be tested many times without danger of failure. In interpreting the results, it must be borne in mind that the model represents the prototype only up to the elastic limit. To study the actual characteristics of the prototype at failure requires a more elaborate model, and a very expensive one, which can only be tested once.

The model was tested both in free and in forced vibration. In a photograph, Fig. 7, it is shown on a shaking table which imparts a vibratory motion to the base of the tank. Tests were made by suddenly releasing the table from a pulled-back position, thus producing a motion of cosine form. The amplitude and period of the table's motion were varied through a wide range. Photographic records of the motions were made on an open time scale. In addition to the model tank, a simple inverted pendulum was put on the shaking table. This pendulum was so proportioned that it represented the behavior of the prototype with the water frozen solid, so that the effect of the water in a liquid state on the earthquake resistance of the structure could be determined directly by comparing the records of the model and the pendulum. The inverted pendulum also served as a check on the accuracy of the laboratory work, since a theoretical solution can be easily obtained for its motion.

Typical plotting of the resulting data is given in Fig. 8 (*a*) and (*b*), the latter being near the lowest mode in frequency, where the non-linearity is quite apparent. The light dashed curves are for the simple inverted pendulum. It is seen that the water has a cushioning effect on the motions; this seems to be true for all standard types of elevated tank towers.

One is struck by the fact that the elastic limit is reached by very mild accelerations and with ground motions of very short duration. This fact is important because, although in an actual quake there is little likelihood of a long-continued series of harmonic waves of the same frequency, yet it is quite possible that there will be two or three waves of the same or nearly the same frequency coming together. For the most part, it was found that two or three equal waves in succession would do almost as much damage to the structure as a long train of equal waves. Until actual earthquake motions can be reproduced, more or less simple laboratory motions must be used and a certain amount of engineering judgment

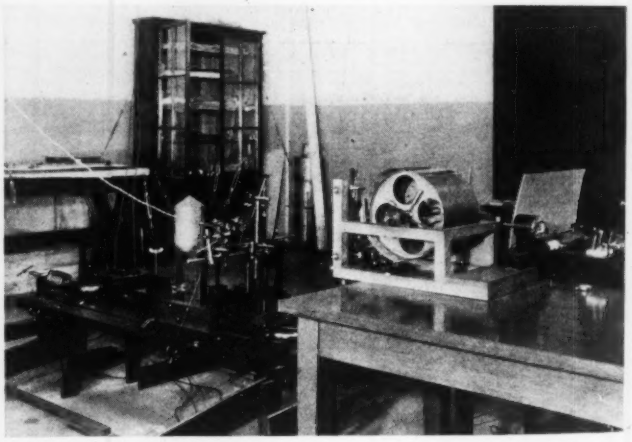


FIG. 7. MODEL OF WATER TANK IN POSITION ON SHAKING TABLE

must be applied in interpreting the results. A new type of shaking table, which will reproduce arbitrary motions perfectly, is now being developed at Massachusetts Institute of Technology.

A partial summary of the results for the design studied is given in Fig. 9. These curves are purposely restricted to earthquake motions containing only one and two equal period vibrations in succession in order to illustrate the observations made in the preceding paragraph. They also show clearly the inadequacy of the usual statical method of analysis for quake-proof design. It might be supposed that by using a "factor of safety" the statical method would be safe to use. However, a little consideration will show that this is not the case. Changing the strength of the tower merely moves the resonance periods to other points along the horizontal axis and does not appreciably change the quake resistance of the structure. Indeed, if the strengthening of a tower happens to bring its period into resonance with the earthquake period (assuming it was not in resonance before strengthening) actually a dynamically weaker structure will be obtained for the added trouble and expense.

Probably such misconceptions have arisen as a result of the common tendency to think and speak of earthquakes as "forces." Earthquakes are not forces; they are inexorable motions so far as engineering works are concerned, and they cannot be treated as forces except under certain special conditions. The forces set up by an earthquake exist solely by virtue of the structure itself, and their magnitudes depend upon the character of the structure. A tremendous sea wave would exert very little force on a needle held in its path but might wash a whole city away with ease—such is the nature of an inexorable motion. The answer to the problem lies in applying dynamics to quake-proof design. We have far to go before this can be made a practical engineering procedure, but model study affords a straightforward and feasible approach.

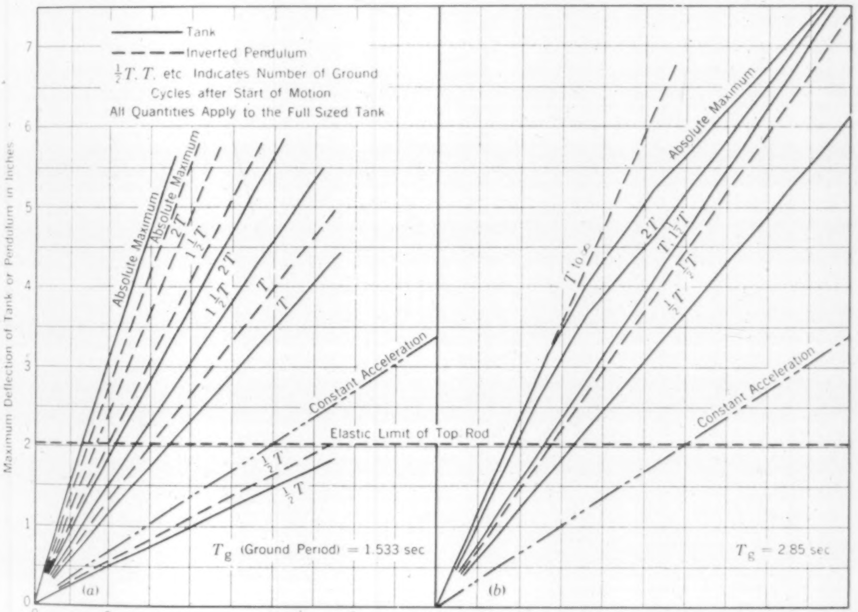


Fig. 8. Typical Plottings of the Data Obtained for Tank and Pendulum
(*a*) For Usual Frequencies; (*b*) For Low Frequencies

A comparison of laboratory results with measurements of the vibrations of full-sized tanks made by the U. S. Coast and Geodetic Survey in California, indicates that the model method is remarkably dependable, even for very small models, if they are properly constructed.

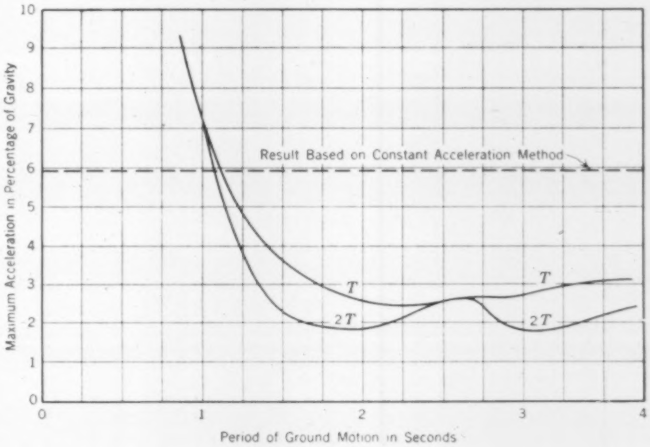


Fig. 9. Partial Summary of Results of Tank Model Experiments

Showing the Maximum Acceleration Required to Reach the Elastic Limit of the Top Rods During One or Two Complete Ground Vibrations

Actual field checks of this kind are of the utmost value in guiding model research and in interpreting results obtained in the laboratory. The far-sighted attitude of the government in making field studies of the vibration characteristics of engineering structures is certainly commendable. It is perhaps hardly necessary to say that the work is being done with the same care and thoroughness which characterize the work of the Coast and Geodetic Survey in general.

The research project here described was sponsored by the Freeman Engineering Corporation of Providence, R.I., and by the Associated Factory Mutual Fire Insurance Companies. It indicated clearly that truly quake-proof tank structures cannot be economically achieved with the present types of construction, and that a moderate amount of reinforcing (as is used in so-called "quake-proof design" today) adds very little to, or may even reduce, the ability of the structure to withstand earthquake motions. Further research at Massachusetts Institute of Technology is being directed toward the development of designs for towers which are especially suited to seismic regions. This work has not yet been carried far enough to be made public, but the results so far have been very encouraging.

In closing, it is appropriate to express my deep appreciation of the work of the late John R. Freeman, Hon. M. Am. Soc. C. E., who was a constant source of inspiration to so many of us and who did so much toward awakening the engineering profession in America to the necessity of facing the earthquake problem in a realistic and scientific manner.

Federal River and Harbor Policies

Development of a Vital Medium of Transportation Under the Direction of the Corps of Engineers

By LYTLE BROWN

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS

MAJOR GENERAL, U. S. ARMY, COMMANDING ATLANTIC SECTOR, PANAMA CANAL DEPARTMENT, FORT DE LESSEPS, CANAL ZONE

NATURE has been lavish in providing this country with plentiful harbors, well situated, and a remarkable system of inland navigation both by river and lake. Congress even in the early days recognized its responsibilities with regard to waterways; it asserted and has continued to maintain its control. From the beginning the Corps of Engineers in the War Department was delegated to provide technical service, both in helping to determine the desirable course of development and in handling the construction work. Because of his recent experience as Chief of Engineers, General Brown speaks in this article with the fullest knowledge. He epitomizes the growth of river and harbor work, its obstacles and its successes, particularly dwelling on the various government agencies concerned and the routine followed in originating and developing projects. A second article will follow in a few months, detailing some of the particular problems encountered in federal river and harbor work. These articles have been prepared from General Brown's remarks before the annual meeting of the Panama Section of the Society on December 10, 1934.

FOR more than a hundred years the rivers and harbors of the United States have been improved for navigation or commerce by the federal government. The governmental agency to which this work has been assigned since its beginning has been the Corps of Engineers of the Army, in the War Department.

This activity by the government was questioned by politicians a hundred years ago as not authorized by the Constitution. Today no one questions the power of the federal government in this particular; the constitutionality of the work lies in the commerce clause of the Constitution. When John Quincy Adams was president, he was ardently in favor of public works such as river and harbor improvements and post roads. His opponents were antagonistic to this program for political reasons, and whenever they lacked arguments they went back to the Constitution to find them.

EARLY OBSTACLES OVERCOME

Andrew Jackson vetoed a road bill. Also I have seen a letter of his which in condemning a bill for river and harbor improvements stated in effect: "Congress should stop this corrupt log-rolling legislation; if they want to do work of this kind let them have the Constitution amended." In this connection it is rather amusing to consider his later views in this matter. He was greatly interested in promoting the settlement of the Red River valley by Americans for the reason that the boundary line between the United States and Mexico above the headwaters of the Sabine was not clear. Jackson wanted no Mexican territory in the valley of the Mississippi, and he felt sure of his ground if Americans held the land in the Red River valley. The navigation of this river was essential to the settlement of the valley. But there was a huge raft of timber in it blocking its channel to all navigation at low stages. This raft was about a hundred miles long, and the President had no objection to signing a bill appropriating a large sum for its removal—at least, I have seen no objections on record. When something ought to be done for the general welfare, and no violation of the well-recognized rights of citizens is involved, it is difficult to find objections in the Constitution to proper action.

The feeling against permitting the federal government to do any work or spend any money for local benefit was shown in the constitution adopted by the Confederate States of America, which forbade such work unless the funds were raised by the localities concerned.

Not a great deal of work was done on rivers and harbors by the federal government prior to the Civil War; the removal of obstructions and slight assistance to natural forces was about all. Private enterprise did much more. Rivers were improved and canals constructed by states and private capital. Then the railroads began to absorb all available private capital and to array it against all other forms of transportation, especially the competing forms of roads, rivers, and canals. The Erie Canal was built by the State of New York on the lowest grade line from the Coast to the Mississippi Valley north of Georgia. This canal is still in use because it was built and operated by the state.

PROGRESS DESPITE OBSTACLES

The great railroad systems which began to grow by leaps and bounds after the Civil War were not long in stirring up dissatisfaction. They were in private hands and operated for profit. They held the business of the country and its development in their grasp, no doubt. As opposition grew, people began to take interest again in water transport. The central government responded by improving channels for navigation, and the amounts of expended money for that purpose have been increasing steadily.

Where the expense of providing channels is not too great, transportation by water is without doubt cheaper than that by rail. This is recognized and the channels are demanded. Since the Civil War the increased draft of ships has required much greater depths in harbors. Or perhaps it was the other way round—the ability to secure these depths has permitted a great increase in the size of ships.

Gradually many harbors on the Atlantic, the Gulf, and the Pacific coast have been developed that can take the largest freight ships. The connecting channels and many harbors on the Great Lakes have been deepened so as to accommodate lake carriers up to 16,000 tons, drawing over 20 ft of water and furnishing one of the most economical means of transport known to the world. Work on the river systems has lagged. The railroads have opposed it strenuously at all times, using all the power at their disposal, including the large personnel employed by them. Nevertheless considerable improvement has been made on the Mississippi from its mouth to St. Louis, on the Ohio from its mouth to its source, and on the Monongahela. Active work is now going forward on the Mississippi from St. Louis to Minneapolis; on the Missouri from its mouth to

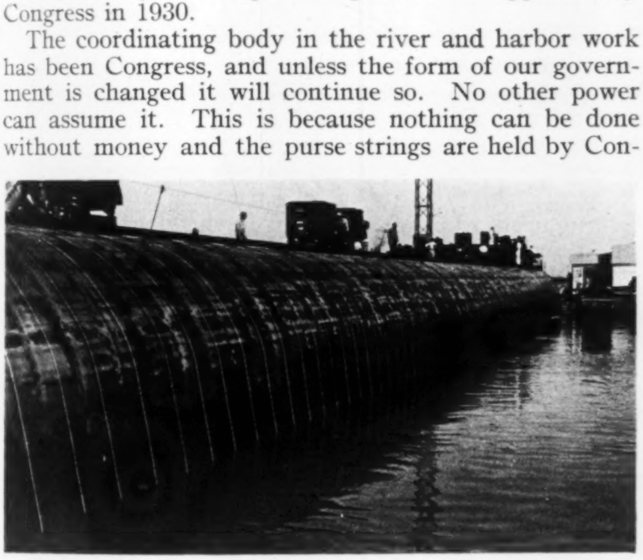
Sioux City; on the Illinois from its mouth to Chicago; on the Great Kanawah from its mouth to the limit of its capacity for improvement; on the Tennessee from its mouth to Knoxville; on the Sacramento from its mouth to Sacramento; and on the Columbia from its mouth to the mouth of the Snake River. On the coast an intra-coastal canal from the Delaware to Miami, Fla., and on the Gulf from Pensacola, Fla., to Houston, Tex., is being rapidly developed.

Connecting our two coastal groups of great harbors is the Panama Canal, built between 1903 and 1914. This forms a connecting link in the American system of transportation and also is an artery of world commerce—indeed a part of the sea lanes of the world. This canal belongs to the United States and doubtless will remain in its keeping as long as the waterway continues to be essential to the defense of the country. It must be made to pay for its cost, maintenance, and operation. Properly used and secured, it may be an instrument for the maintenance of world peace and prosperity.

POLICIES IN DEVELOPMENT

Today the policy on rivers and harbors is entirely in the hands of Congress. The manner of handling the matter has been in process of development for over a hundred years. During the recent depression some of the authority has undoubtedly been handed over to the President and has in turn been allotted by him, under his supervision, to the Administrator of Public Works who has had much to say about the allotment of funds to various works. In the Tennessee Valley the law has created an authority directly responsible to the President, which is engaged in the execution of plans largely formulated by the Corps of Engineers, and approved by Congress in 1930.

The coordinating body in the river and harbor work has been Congress, and unless the form of our government is changed it will continue so. No other power can assume it. This is because nothing can be done without money and the purse strings are held by Congress. In that body there are two powerful committees that handle the subject, the Committee on Rivers and Harbors in the House and the Committee on Commerce in the Senate. It is in these committees that plans are ultimately threshed out and bills prepared for presentation on the floor of the House and the Senate.



ASPHALT MATTRESS PLANT LAYING MATS IN FRONT OF ENGINEER DEPOT, NEW ORLEANS

Last Section of Mat Has Been Laid. Cables Will Not Be Cut Until the Mat Rests on the Bottom

Although the river and harbor bills approve plans and costs, they do not make appropriations for the execution of works. The appropriations are made on departmental appropriations bills, which are handled in the House and Senate, respectively, by the committees of Appropriations and Finance. To serve as guides to the committees, the departments furnish estimates of funds. In so far as rivers and harbors are concerned, these estimates are based on projects or plans that have themselves been approved or adopted by Congress and are given the scrutiny of the Bureau of the Budget before going to Congress. The Bureau, formed shortly after the War, in Harding's administration, is an agency that reports directly to the President. It takes orders from him and receives its general instructions from him, and therefore reflects what he probably will approve in the way of appropriations. It is indeed the coordinating agency of the executive department as regards funds for the different departments.

WINOOSKI RIVER FLOOD CONTROL PROJECT, VERMONT

Looking West Above Spillway, Wrightsville Dam. Work by Civilian Conservation Corps Under U. S. Engineer Office

All details as regards rivers and harbors are handled by the Corps of Engineers in the War Department. It makes the surveys, estimates, and investigations of all projects that Congress had ordered examined; it prepares the plans and executes the work of construction; it maintains the works after they are built, and operates them where operation is required; it prepares the annual estimates, which go through the Bureau of the Budget to the House of Representatives.

By law the Corps of Engineers is kept strictly on an engineering basis. It can advocate or promote nothing and can initiate nothing. It must have the prior sanction of law for everything it does that requires the expenditure of money or may lead to such expenditure. This feature, which removes the Corps of Engineers absolutely from the rôle of the promoter and the advocate, is very largely the reason for its reliability. When its plans and its estimates are attacked, I would, were I in Congress or in other high place of judgment, look very closely for self-interest on the part of its critics. When estimates and testimony are tinged with self-interest there is ample reason to question their accuracy and credibility or to discount them severely. When an engineer becomes a promoter he needs watching; he has left the ranks of engineers.

In the formation of a project the initiative does not come from the Corps of Engineers, nor does it really come from Congress. It comes from interested people as it should; they take it to their representatives in Congress. It must find its way to the Committee on Rivers and Harbors of the House. The proponents are asked to come before that committee and present their views. If these views are looked upon as practicable and reasonable, an item is inserted in the next bill for rivers and harbors directing the Chief of Engineers to make an examination of the proposed project.

Upon such instruction the Chief of Engineers with his own organization, which is large, experienced, and capable, assisted by such outside consultants as are needed, makes the examination. All parties, both those interested in and opposed to the project, are given full opportunity to present their case with all data available.

AERIAL VIEW OF DAM NO. 41 ON THE OHIO RIVER

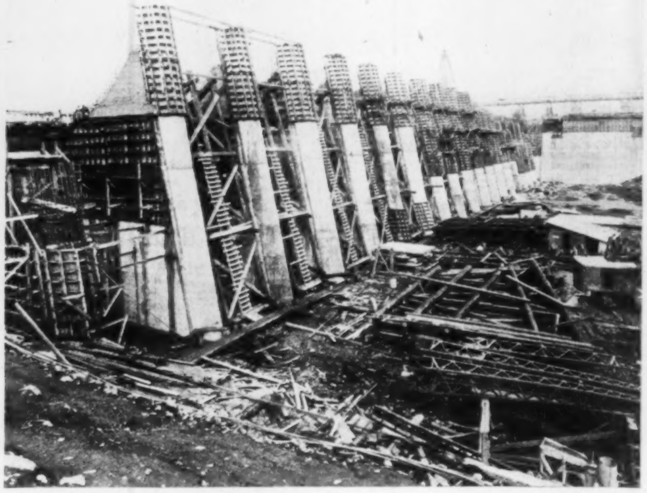
If the proposition appears feasible and desirable on preliminary examination, a physical survey may be authorized by the Chief of Engineers. This survey is for the purpose of presenting a plan and reliable estimate of cost. The final report on the investigation is studied and reported upon by the Board of Engineers on Rivers and Harbors and by the Chief of Engineers. It is then forwarded to Congress through the Secretary of War.

This Board of Engineers on Rivers and Harbors is a body having long experience in river and harbor work, with a background of information permitting it to render promptly opinions of considerable reliability. To this board, created by law about 1902, every project must be submitted before transmission to Congress. This board, local boards, and the committees of the House and the Senate hold public hearings on all projects, at which both advocates and opponents may present their views fully with all the evidence they may have.

VARIOUS SAFEGUARDS PROVIDED

In all matters the final power lies with the President and Congress. The latter embodies into law the necessary coordinating and authorizing orders; the President has the power of approving the final action or disapproving it by veto. A veto applied to any congressional act not of a fundamental nature or of wide political interest almost certainly kills it unless the opposition party is very powerful. If possible, the advocates of a river and harbor bill, usually through the chairman of the committee in Congress, assure themselves of the attitude of the President before the bill is committed to the floor for vote.

From what has been said it may be realized how rocky is the road a project has to travel before it is adopted, and especially before any money from the United States treasury may be expended on it. It may be said with equal truth that politics may further the adoption of a project, and may prevent it. Furthermore, as may be claimed without disturbing the equanimity of a citizen or his faith in his government, politics is involved in everything that affects the welfare of the people of the Republic. Otherwise there would be no democratic principle in the government.



PROGRESS OF BONNEVILLE POWER HOUSE ON THE COLUMBIA RIVER
Substructure from Upstream Side as Seen on March 18, 1935

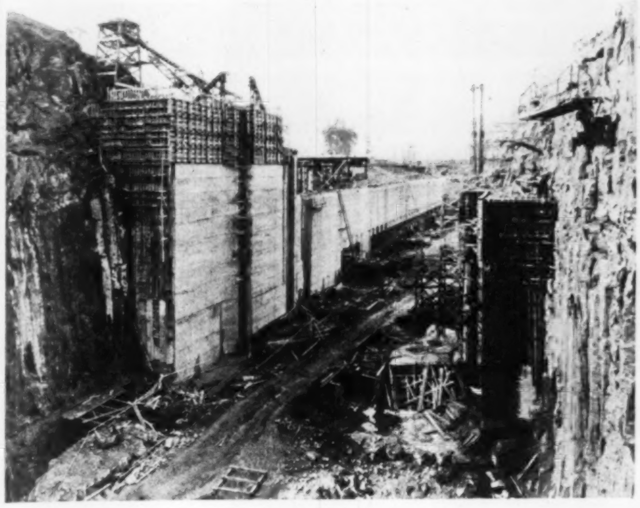
With regard to river and harbor projects, there is one very strong force which tends to prevent error or chicanery and that force is the Corps of Engineers of the Army. It is without the influence of politics; no member owes his place to political machinery; and its reports, as required by law, are not the reports of promoters, of boosters, or of self-interested advocates, but of engineers who are impartial in the strictest sense of the term.

Often this question has been asked: Why is the work on rivers and harbors under the War Department since it is not concerned with war? Those who ask are usually resentful, and may have some self-interest to promote,

TYPICAL VIEW ON INLAND WATERWAY FROM DELAWARE RIVER TO CHESAPEAKE BAY
The Structure Is the Pennsylvania Railroad Vertical Lift Bridge

though there may be some who are honest, seeking for knowledge, or patriotic in desiring a better organization.

Any of the great departmental subdivisions could take care of the work, such as the departments of the Navy, Commerce, Interior, or Agriculture. Construction of roads is in the Department of Agriculture, reclamation in the Department of the Interior, lighthouses in the Department of Commerce. It is really of but slight importance what department bears the responsibility except that those matters which are very closely related and interdependent ought to be handled in the same department. In our government this is usually very clearly recognized and followed as a practical necessity. The independence of really great movements is usually an incentive to development. It is not likely that the automobile industry would have developed as it has if it had been a branch of the railroad industry—a combination that might seem reasonable since both are concerned with transportation. If a slow horse and a fast horse are joined too closely together, the fast horse might as well be slow.



Scene at Navigation Lock Work, Bonneville Project on the Columbia River

End of Lock and Downstream Guide Wall on March 18, 1935

There was a reason why the work of rivers and harbors was originally assigned to the War Department and there is reason in its remaining in that department. In the beginning there were practically no engineers, native born, in the United States except those produced at the first scientific school of America, the U. S. Military Academy at West Point. The work is in the War Department now because for over a hundred years it has been done there honestly and well. A better reason for allowing it to remain there cannot be found.

View at the Soo Looking Toward Lake Huron, Present Lock Development at Sault Ste. Marie, Mich.

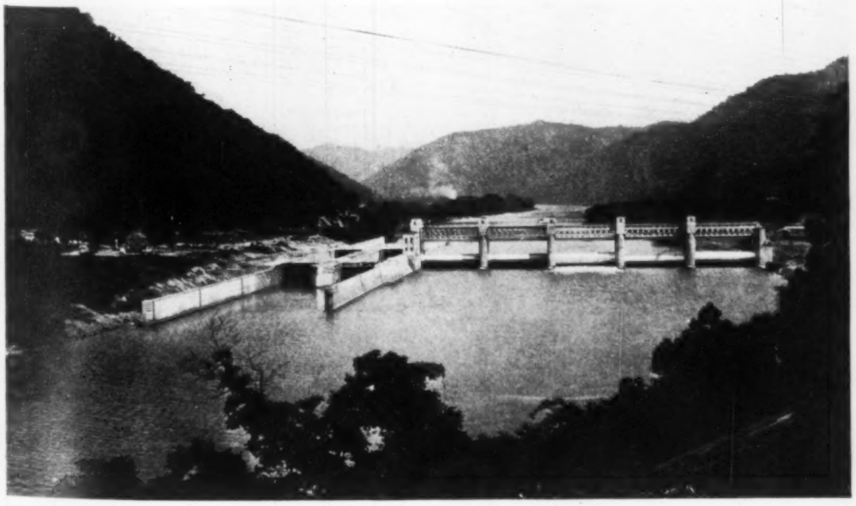
Showing from Left to Right, Fourth, Davis, Poe, and Weitzel Locks

Usually transportation systems are built to meet the normal needs of a country, and usually they are not fully equal even to these normal demands, owing to lag and inertia in building as well as to a general business tendency not to exceed demand. The result is that transportation facilities are always overtaxed in an emergency such as war, which puts an added burden on them.

VALUE IN NATIONAL DEFENSE

All harbors are strategic points for shipping. Along our extensive coast lines they would be a great asset in case of war. They make the successful blockade of the United States a gigantic undertaking for any power. The blockade of the Southern ports in the Civil War was a mighty task, few as those ports were, and yet this blockade was one of the strategic operations vital to the outcome. In that war the use of the navigable waterways as lines of communication was essential, as was illustrated at Richmond and Vicksburg.

It should be noted, furthermore, that the use of the Corps of Engineers of the Army on some great, widely distributed phase of public work is necessary to the engineer organization for war. The Corps must know practical engineering; it must be familiar with the engineer personnel, materials, plant, and methods of the country. It cannot fulfill its function if it does not have such experience. The development and history of the Corps in relation to river and harbor work give ample assurance that any engineer work entrusted to it in war will be adequately and capably handled. And in war the construction work must be centralized for control though decentralized for execution.



General View of Dam and Lock No. 3 on the Kanawha River at West Virginia

View Looking Upstream

A Refrigeration Terminal on Tidewater

Some Engineering Problems Encountered in Developing the Indian River Plant at Fort Pierce, Fla.

By GEORGE PERRINE

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS

FORMER PRESIDENT, CHARLES E. LUND AND ASSOCIATES ENGINEERING CORPORATION, FORT PIERCE, FLA.

AIDED by federal funds, an interesting refrigeration and cold-storage plant has recently been completed at Fort Pierce, Fla. That this project could readily meet the rigid requirements for government aid is evident from a consideration of its unusual site and markets. Centered in a rich citrus belt, it filled a real demand; located on an inland waterway, it had direct access to the Atlantic; and with convenient rail connections it was especially fitted to handle incoming or outgoing goods. Besides discussing these considerations, Major Perrine outlines the arrangement of the plant for efficiency, the refrigerating procedures adopted, and something of the civil engineering features involved in building foundations within the pier and adapting the floor steel to welded connections. Although this project may be considered as somewhat unusual in civil engineering activities, many engineers will enjoy it as an account of a commercial need, economically met by the application of good engineering design and construction.

AS AN engineering and commercial problem, the refrigeration terminal recently completed at Fort Pierce, Fla., has a number of phases worthy of consideration. It is on the Indian River, which is in reality part of a coastal inlet extending along most of the eastern shore of Florida and formed by a series of longitudinal islands, with only occasional breaks through to the ocean.

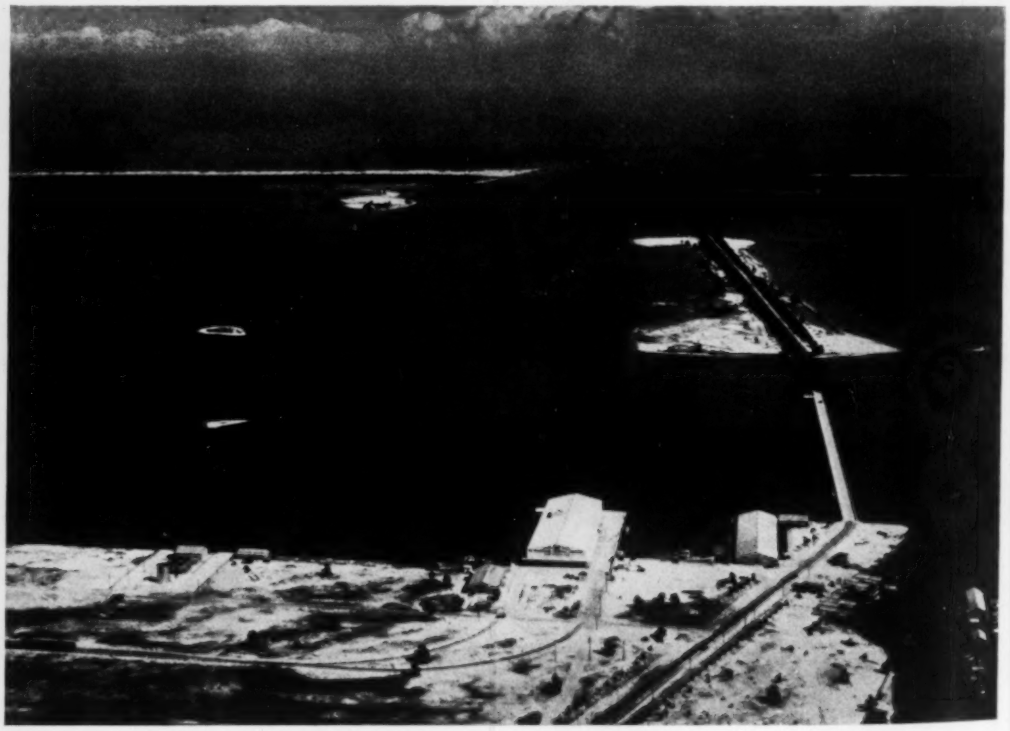
Such a break, the Fort Pierce Inlet, was an important factor in the location of this refrigeration terminal, directly opposite, on the Indian River (Fig. 1). This part of the state is one of the most fertile and productive, particularly of fruits. The Indian River citrus fruits are known throughout the country. Many trainloads are shipped during the growing season and there is a corresponding demand for shipment in coast vessels. On account of the large capacity of such ships, a storage capacity of thousands of tons is required. Furthermore, to preserve and hold these delicate fruits, refrigeration is important. Fort Pierce was the logical location for such a terminal since it has direct access to the best, and in fact the only, ocean inlet along that part of the coast. Furthermore, the Indian River on which it stands, is part of the intercoastal canal from Miami to New York, a considerable part of which has already been completed.

CONDITIONS DETERMINE LOCATION

Although its primary purpose was for precooling citrus fruits and vegetables and then storing them, the Indian River Refrigeration Terminal Plant was also designed for cold storage of carcass meats, case meats, and dairy products such as eggs and butter. In addition, it includes a large transit shed for the handling of general merchandise.

In designing the plant the engineers had many important facts to keep in mind, for not only must this type of terminal be equipped to rapidly and efficiently pre-cool large quantities of fruits and vegetables, but it also accumulates these commodities and holds them in proper storage under correct humidity and temperature conditions pending shipment. Furthermore, the plant had to be very flexible from an operating standpoint to meet the varying load demands.

Fort Pierce is in the heart of the famous Indian River citrus belt, and the plant is situated on a pier on Indian River near the northerly limits of the city. It is served by three spur tracks, one on the north side and two on the south, all connected with the main line of the Florida



FORT PIERCE PLANT AND ITS SHIPPING FACILITIES
Indian River in Foreground; Inlet from Atlantic, Through Sand Bar, in Middle Background

East Coast Railroad. One quarter of a mile of hard surface road connects the terminal with the Dixie Highway, a north-and-south through route.

The pier is 422 ft long on the north side, 364 ft wide on the south side, and 175 ft wide at the outshore end. It is of the sand-filled type retained by steel sheet piling, capped with 3 by 3-ft reinforced string pieces. Outside of the piling creosoted timber fender piling and walers have been driven.

On each side of the pier there is a slip 125 ft wide dredged at present to a depth of 22 ft below mean low water. These slips connect directly with a turning basin of ample proportions to handle any sea-going vessel. The basin is in turn connected to the Atlantic Ocean by a 200-ft channel. Both channel and turning basin are dredged to a depth of 22 ft.

In addition to this channel, there is an 8-ft barge channel 100 ft in width for the entire length of the Indian River from Miami to Jacksonville. The channels and turning basin are maintained by the U. S. War Department. Plans are on foot to increase the depth of the slips, turning basin, and Atlantic Ocean channel in the near future to accommodate ships of deeper draft.

PLANT VIEWED AS A WHOLE

As indicated in the photographs, the plant covers most of the area of the pier. The building itself is a two-story structure 362 ft long, 105 ft wide. The framework is structural steel with bays 20 ft by 20 ft in the interior, and 21 by 20 ft on the outside. The floors are of reinforced concrete designed for a live load of 350 lb per sq ft, supported by steel columns on reinforced concrete footings, which in turn are supported on wood pile foundations in the interior of the pier and independent of it. Exterior walls are of reinforced concrete to a height of 7 ft 6 in.; above this, corrugated asbestos siding is used and the roof is of similar material.

As will be seen from Fig. 2, the first-floor plan of the building is divided into five parts. The westerly section is occupied by four precooling rooms and their fans, with a capacity of 2,000 boxes of citrus fruit in each room. Next is an anteroom and then two large holding rooms. Another large section contains the engine room and the plant office. Finally, the easterly half of the building, adjacent to the offshore end of the pier, is occupied by a transit shed 103 by 140 ft.

On the second floor the building is divided north and south into nine rooms, eight of equal size, each 40 ft wide, and one room somewhat smaller. Seven of the larger are holding rooms for fruits and vegetables under refrigeration. The remaining large room is for general cold storage of perishable commodities. The smaller room is a meat room and is equipped with an overhead trolley track for hanging carcass meats. On the north of these rooms is an anteroom 12 ft 6 in. wide extending the whole length of the building. From it, as shown by the photographs, direct loading to ocean vessels may be effected.

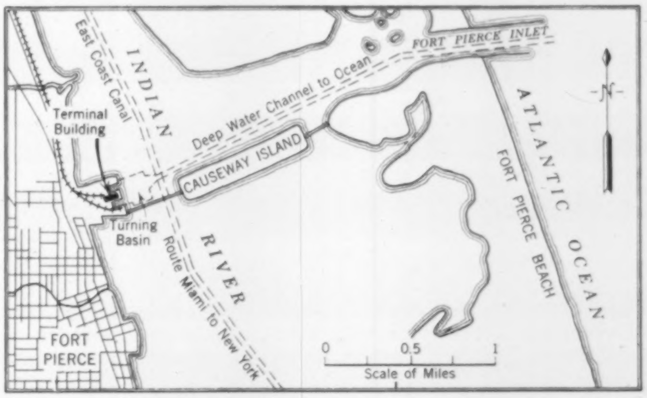


FIG. 1. GENERAL PLAN, SHOWING STRATEGIC LOCATION RELATIVE TO FORT PIERCE, THE INDIAN RIVER, AND THE ATLANTIC OCEAN

All the exterior walls of the building are insulated with cork-board 4 in. thick, laid in 2-in. layers. The floors and ceilings of all the cold rooms are likewise protected.

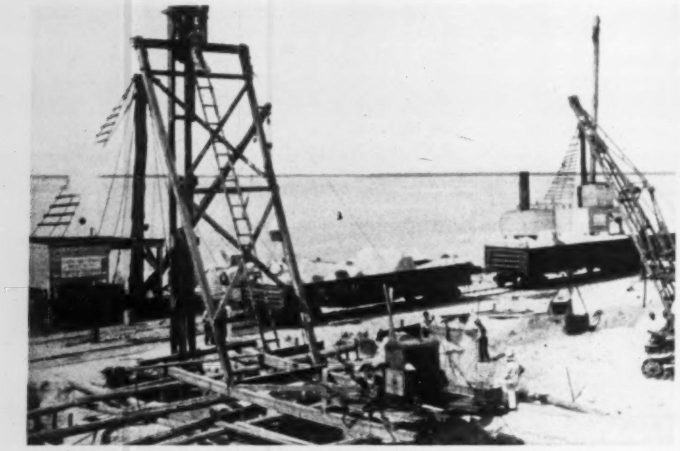
The area of cork insulation in this plant is the largest in the State of Florida. The results obtained in operation since its completion indicate that it is very efficient. Tests were made by the Frick Company, which installed the refrigerating apparatus, maintaining the temperature at 20 F for several hours. As this is considerably lower than the operating temperature, it proved that the facilities were ample to maintain normal cooling conditions without difficulty.

SOME REFRIGERATION APPLIANCES

Civil engineers may be interested in the mechanical equipment

GENERAL FEATURES OF DOCK AND SUPERSTRUCTURE HOUSING REFRIGERATING PLANT
Plant Building (at Left) Is 362 Ft Long, 105 Ft Wide

needed for such a plant. In the engine room there are three 10 by 10-in. vertical compressors electrically driven, with a capacity of 75 tons of refrigeration each. One of the ammonia compressors is equipped with a control device permitting of operation at any desired rate from full to 50 per cent of capacity. All the compressors are cross-connected so that each can be used on any part of the system, thus affording a very flexible plant.



FOUNDATION WORK IN PROGRESS
Crane Digs Pits While Driver Sinks Building Piles

Brine is circulated from an open tank of 1,560 cu ft capacity by means of three direct motor-driven brine pumps, which of course are all cross-connected so that one or more pumps can be used as the load requires. Cooling water for condensing is obtained from two artesian wells driven to a depth of approximately 950 ft and located under the platform on the north side of the building. The wells deliver 950 gal of water per minute at 75 F. After being circulated this water is discharged into the river at 81 to 82 F.

Fans draw the air from the air washers and force it through a continuous plenum above the pre-cooling rooms, numbered 1 to 4 in Fig. 2, whence it is discharged by mechanically operated dampers into the rooms. It is then exhausted through the slatted floor into a lower plenum similar to the one on top, and returned to the air washers to be again humidified and cooled.

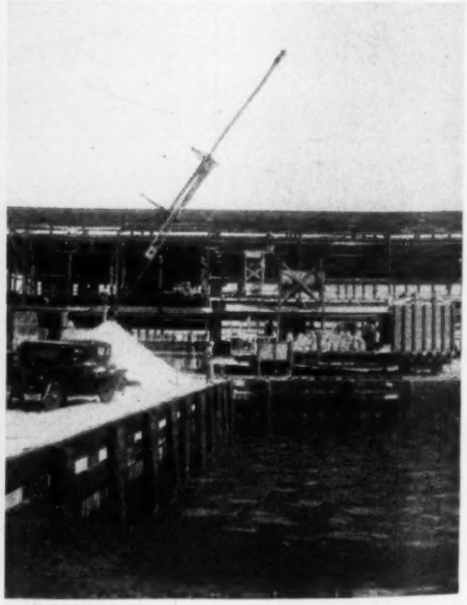
In each of the nine holding rooms on the second floor, air is drawn through the air washers by means of a fan and discharged through a duct running along the ceiling the length of the rooms. This air-distributing duct is of galvanized sheet metal and is provided with outlets dampered to control the air velocity. The meat room, general storage room, and anteroom on the first floor are cooled by direct expansion coils. Here again flexibility has been obtained by installing two cooling units and fans and by arranging the ducts with air inlet and outlet openings so that either cooling unit can be used on either pre-cooling room. It is a simple matter to shut off air from the pre-cooling rooms for loading and unloading.

On the first floor, between the pre-cooling rooms and the cold storage rooms, there is an anteroom 20 ft wide, Room 5 in Fig. 2, extending across the building. Into this fruit is taken from the pre-cooling rooms; thence either (1) it is transferred to platform conveyors for loading into cars or vessels; (2) it is transferred to holding rooms on the first floor for cargo accumulation; or (3) it is transferred by conveyors to the second floor holding rooms. This anteroom is refrigerated by direct expansion side-wall coils and is piped for a temperature of 32 to 35 F, so that it can also be used for general emergency storage when the pre-cooling rooms are not in full operation.

Direct expansion cooling coils are provided in the fresh-meat storage room, which is fully equipped with beef track rails and overhead cooling coils with bunker pans beneath, and a general storage room which will be used for miscellaneous cold storage purposes. In each of the other nine cold storage rooms on the second floor refrigeration is secured by means of a brine spray fan cooler. The cold brine is circulated from the brine cooling tank in the machinery room on the first floor to the various storage room units, to which it is admitted automatically as required to maintain proper dewpoint temperature. Air is drawn through the brine spray units

PILE DRIVER OPERATING AT NORTHWEST CORNER OF DOCK
Sand Filled Dock Was Built in 1929

DRIVING SECOND ARTESIAN WELL 935 FT DEEP, ADJACENT TO NORTH WALL OF PLANT



PORTABLE CONCRETE MIXER AND CRANE PLACING CONCRETE FOR SECOND FLOOR LOOKING NORTH by means of fans, which discharge the air by overhead ducts to all parts of the rooms. The ducts are provided with dampered outlets so that an even distribution of air can be maintained. This type of room refrigeration permits definite control of humidity as well as of temperature, obtained by suitable equipment for each storage room independently and automatically.

OPERATING CAPACITY IS AMPLE

Because of the physical limitations of the refrigerating system, several factors determine the period required for the pre-cooling of citrus fruits. These are the temperature at which the fruit arrives, the temperature to which it must be pre-cooled, and the number of rooms being cooled at the time.

To pre-cool oranges from the initial pulp temperature of 75 F to a holding temperature of 38 F requires 22 hr if all four rooms are operating, 20 hr for three rooms, 18 hr for two rooms, and only 16 hr for one room. Naturally, the lower the pulp temperature at which the fruit is received, the shorter the length of time required for pre-cooling. Fruits that have a low sugar content are not reduced to such a low temperature. Grapefruit, for example, is usually pre-cooled to 50 F only.

It will be seen that the pre-cooling capacity of the Fort Pierce Plant is 8,000 boxes every 20 hr approximately, or 67 boxes a week. There are seven holding rooms having a capacity of 7,000 boxes each and two with a capacity of 5,000 boxes each, a grand total of 59,000 boxes. Fruit that has been pre-cooled can be held in storage to await shipment either by rail or water, or held by the shipper for a more favorable market.

Thus the plant has a capacity equivalent to 167 carloads of refrigerated and pre-cooled fruit per week. The average cargo for the boats that can be accommodated at the Fort Pierce harbor at this time is about 25,000 crates. This plant is arranged so that it can readily handle 60,000 crates of citrus fruit during each 10-day period. This of course is over and above the miscellaneous cold storage loads. In addition to all this 70,000 boxes of fruit for ventilated shipment can be handled through the transit shed weekly. During the 1934–1935 season the plant had shipped $1^1/_2$ million crates of citrus fruits up to July 7, 1935, and could have handled considerably more if the necessary vessels had been available. During the same period shipments of vegetables and canned fruits amounted to 60,000 packages, and of meat products, several hundred tons.

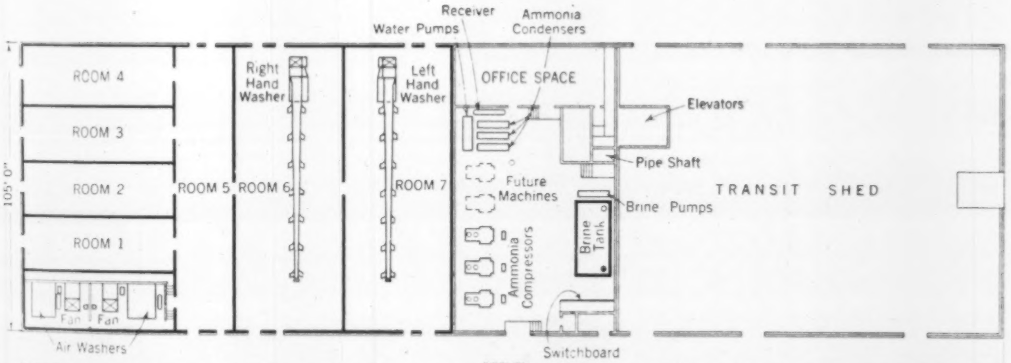


Fig. 2. First Floor Plan, Showing Arrangement of Mechanical Cooling and Interior Handling Facilities

Main Storage Is Provided on Floor Above

It was the intention of the promoters to provide ample additional facilities on the property for the shipment of fish as well as of fruit. The district is one of the leading fishing centers of that part of the sea coast. A great variety of deep sea fish are obtained here in abundance. The untimely deaths of Edwin Binney, president of the Indian River Refrigeration Terminal Company, and of Charles E. Lund, vice-president of the Charles E. Lund and Associates Engineering Corporation, has interrupted continuation of the plans for the future development of the port.

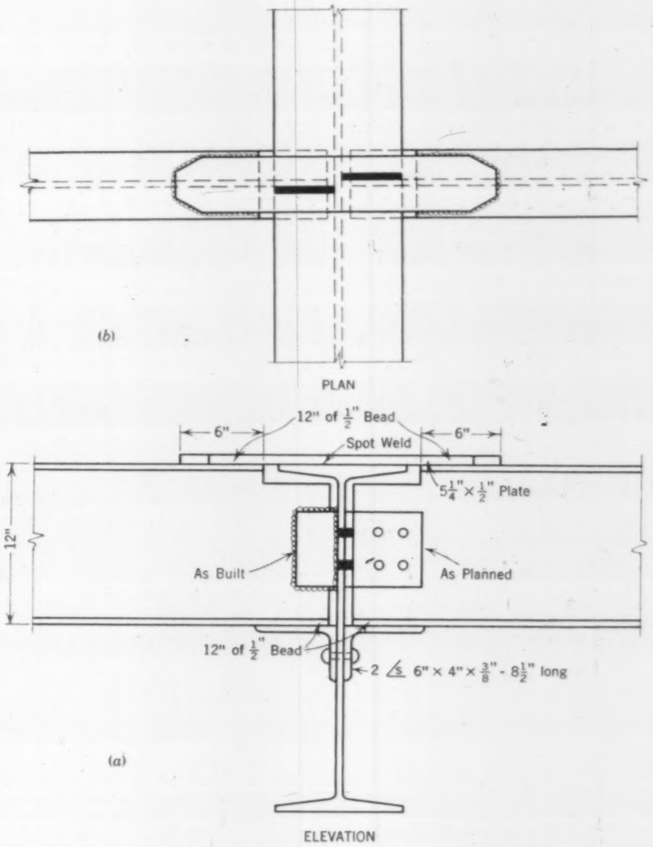

(b)
PLAN
12" of $\frac{1}{2}$" Bead
6"
Spot Weld
6"
$5\frac{1}{4}$" × $\frac{1}{2}$" Plate
12"
As Built
As Planned
12" of $\frac{1}{2}$" Bead
2 ∠s 6" × 4" × $\frac{3}{8}$" - $8\frac{1}{2}$" long
(a)
ELEVATION

Fig. 3. Connection for Second Floor Joists

(*a*) Elevation of Working Drawing Showing (Right) Details for Riveting, (Left) Details for Welding

(*b*) Plan with Details as Actually Constructed

A few of the construction features of this terminal project are of special interest. The dock on which the refrigeration plant stands was built in 1929 by the owners with private capital and was one of the first steps in developing the Port of Fort Pierce. It is of the hydraulic-fill type retained by interlocking steel sheetpiling. The material of the fill is a mixture of sand and sea shells. The shells range from full size to fine powder. The sand is fine, and most of the shell material is pulverized, generally in flaky form, so that when it is deposited by the suction dredge it assumes a horizontal position.

Within this dock the pile foundations for the refrigerating plant were built. When the pits for the pile foundations were excavated to water level in this filled material, the sides of the pit stood vertically as long as they were not jarred or struck by the crane bucket. Although the material as excavated appeared to be dry, it of course held some moisture. The fact that the shells and particles of shells laid horizontally overlapped must have bonded the mass together and enabled the bank to stand vertically. As soon as the pits were excavated boxes of 2-in. plank were placed in them to protect the sides of the pits while the piles were being driven and capped with concrete.

Surrounding the dock is the interlocking steel sheetpiling 35 ft long. The sheets are capped with a 3 by 3-ft reinforced concrete string-piece embedded 1 ft. The top of the string-piece is 8 ft above high water. The steel sheeting is anchored back by $2^1/_4$-in. rods to timber piles, with tops driven to 1 ft above low water and 35 ft back from the sheeting. The sheetpiling, which was said to be copper steel, is in very good condition after five years, although some scaling shows on the surface. The anchor rods which were exposed where they passed through the excavations made for piles were in excellent condition and showed no loss from rust.

NORTH SIDE OF PLANT LOOKING EAST TOWARD ATLANTIC INLET

Crates Pass to Ships Through Doors on Second Floor

WELDED CONNECTIONS IN STRUCTURAL STEEL

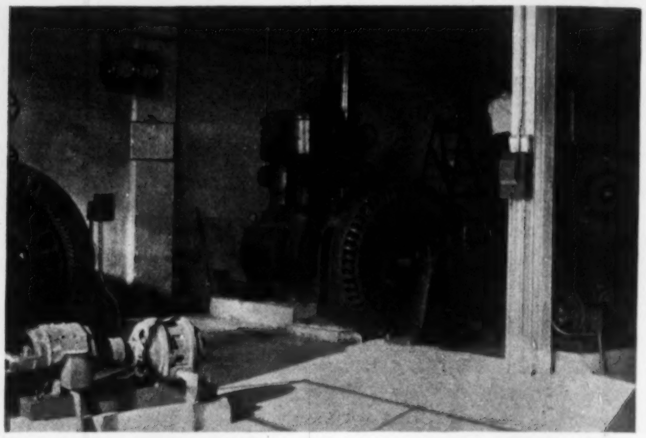
Option was given the steel contractor permitting him to use standard angle connections between floor beams and girders for supporting the second floor, or welded connections (Fig. 3). The contract drawings showed a special plate over the girders for connecting the floor beams on either side and thus obtaining continuous beam action. This upper plate connection was to be used with either riveted or complete welded connections and was welded to the flanges of opposite floor beams and spot-welded to the top flange of the girder. Each floor beam was also fastened to the web of the girder by welded connections, as shown in Fig. 3.

By government regulation, the contractors were required to employ local labor when available. Often certain classes were not available. Take, for instance, electric welders. There are numerous welders of the "tinker variety" who should never be allowed on building construction. Expert welders were finally obtained by the steel-erecting contractor, although he had to rely on a distant source. Steel workers were also obtained from a distance. It was said that some of the local skilled workmen were not available because their pride would not allow them to register for work.

An interesting case illustrating this subject is illuminating. One of the contractors had a faithful and reliable Negro foreman who had worked for the firm for eight years or more. In dull times his pay was $20 per week, and in better times, $24. According to government rules, this man had to be paid $36 per week. In spite of the extra difficulties encountered due to regulation resulting from the present changed conditions under which construction operations are being carried on, the refrigeration plant was completed in five days less than the five months stipulated.

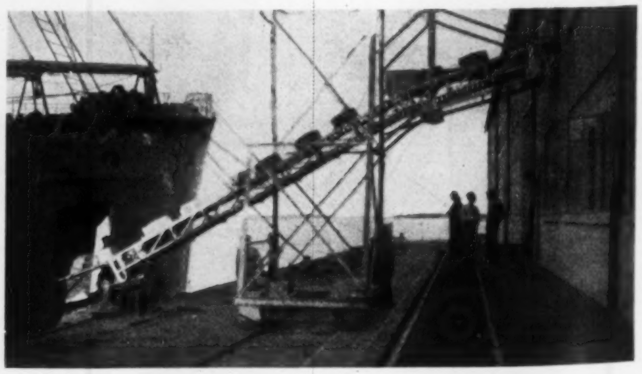
The plant was constructed with funds obtained from the Public Works Administration by the Charles E. Lund and Associates Engineering Corporation, consulting engineers of St. Petersburg, Fla., for the owners, the Indian River Refrigeration Terminal Company of Fort Pierce, Fla., of which the late Edwin Binney was president.

This loan was obtained through the untiring efforts of Jack V. Lund, late president of the Engineering Corporation. It was approved in December 1933; contracts were signed by the borrower and 11 contractors on June 6, 1934; and the plant was completed and put in operation December 1, 1934, at a total construction cost of about $360,000.



MOTORS AND COMPRESSORS IN MACHINERY ROOM, FIRST FLOOR

For the Public Works Administration the project was under Clarence McDonough, M. Am. Soc. C.E., Director of Engineering, and James E. Cotton, State Engineer. Representing the Terminal Company was M. A. Ramsey, Secretary-Treasurer. For the consulting engineers, Robert R. Baker was Resident Engineer and E. R. Stetson, Structural Engineer.



LOADING CARGO SHIP WITH CRATED CITRUS FRUIT FROM SECOND FLOOR

View Taken About January 1, 1935

Constructing Canton-Hankow Railway

China's Main South-Central Trunk Line Road Nears Completion

By H. H. LING

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
DIRECTOR AND ENGINEER-IN-CHIEF, CHUCHOW-SHAOCHOW SECTION, CANTON-HANKOW RAILWAY,
HENGCHOW, HUNAN, CHINA

FOLLOWING the example set by the United States, the British Government, in December 1922, remitted to China the balance of the indemnity exacted for damage and loss of life occasioned during the Boxer Rebellion of 1900. This fund was utilized by the Chinese Government toward the completion of the main trunk railroad connecting Hankow on the Yangtze with Canton, the metropolis of South China. The construction of the remaining 250-mile section from Shaochow to Lochang has presented some difficult problems because of the inaccessibility and ruggedness of the country traversed. In this article Mr. Ling, who is in charge of the work, presents an interesting brief account of the enterprise.

WHILE much has been said about the Great Wall and the Grand Canal as illustrations of China's ancient civilization and engineering endeavor, a good deal may also be written about such modern construction works as, for example, the Canton-Hankow Railway, one of the many projects now being undertaken for the improvement of communication in this vast land.

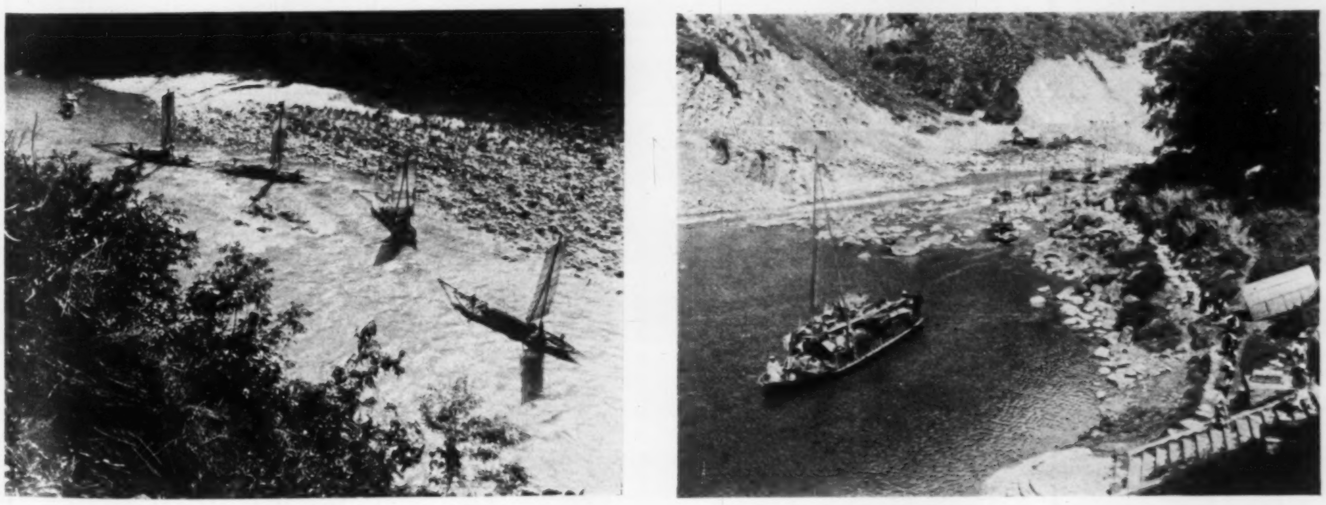
As most of the main rivers of China flow from west to east, land communication from north to south is usually difficult. With the completion of the Peiping-Hankow Railway and the Peiping-Mukden Railway (Fig. 1), there was urgent political as well as economic need for the linking up of Hankow and Canton, so that the central part of China, would be more in touch with the great metropolis of the south. The 680-mile railway connecting these two important cities of China, passes through provinces having a total population of over 90,000,000. The general alignment, also many of the important cities served, are shown in Fig. 1.

Construction was first started at both ends under separate organizations. At the northern end, a section from Wuchang (opposite Hankow) to Chuchow, a distance of 259 miles, and at the southern end, a section from Canton to Shaochow, a distance of 139 miles, were nearly completed when the World War broke out, interrupting the construction at both ends and leaving a gap of 282 miles unfinished. The principal reason for the long delay in completing the project was financial, as the sum needed to complete the remaining 282 miles of line through difficult country was very large, and there was no point in extending it piecemeal.

FUNDS MADE AVAILABLE BY SINO-BRITISH AGREEMENT

Following the example of the United States, the British Government, in December 1922, announced that the balance of the British share of the indemnity of 1901 would be remitted and placed under the control of the Chinese Government to be devoted to purposes mutually beneficial to China and the United Kingdom. It was not until September 1930, however, that notes were exchanged between the British and the Chinese governments in an effort to arrive at a method of using the fund. It was subsequently agreed that the fund should be applied toward creating an endowment that would be used in rehabilitating and building railways and in other productive enterprises in China. As a result, in July 1933 the Chinese Ministry of Railways and the Board of Trustees in charge of administering the Boxer funds concluded a loan agreement in order to facilitate the completion of the Canton-Hankow Railway. According to this agreement, the Ministry of Railways will have at its disposal £1,660,000 for the purchase of foreign materials and about $32,000,000 in silver for work and native materials.

Once the negotiations for the return of the British



TYPICAL SCENES ALONG THE NORTH RIVER, KWANGTUNG PROVINCE
(Left) Small Craft Going Downstream. Boats with 18-In. Draft Can Scarcely Negotiate the Rapids
(Right) Upstream by Tow Rope. Canton-Hankow Railway on the Far (East) Bank

THE OLD AND THE NEW IN CHINA
Concrete Pier for Railroad Bridge Seen Through Ancient Masonry Arch

portion of the Boxer indemnity were actually under way, the Ministry of Railways lost no time in ordering the resumption of construction work under the organization of the Chuchow-Shaochow section in charge of a director and engineer-in-chief. At the time final financial arrangements were being made, the Chu-Shao construction section established its headquarters in Hengchow, Hunan, and work was begun at both ends in July 1933. In September of that year, the construction office was able to complete a section of 31 miles from Shaochow to Lochang, which was turned over to the southern section for operation. The remaining gap then became the 251-mile section from Chuchow, Hunan, to Lochang, Kwangtung.

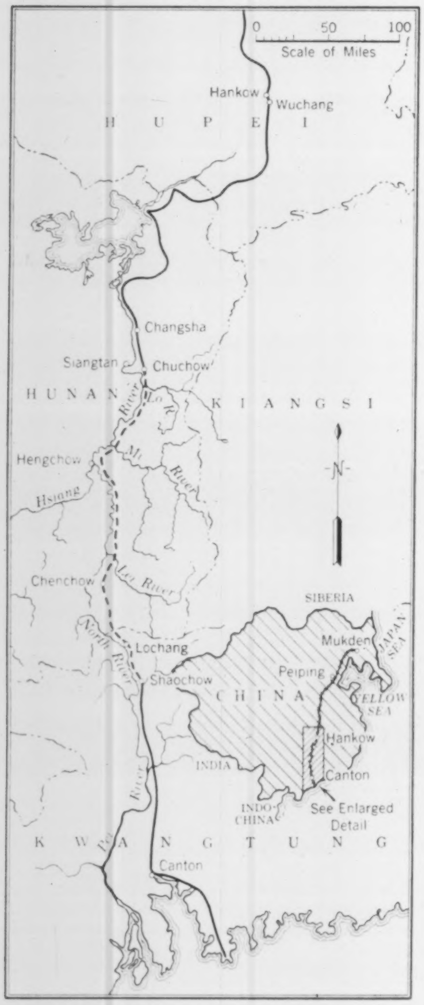
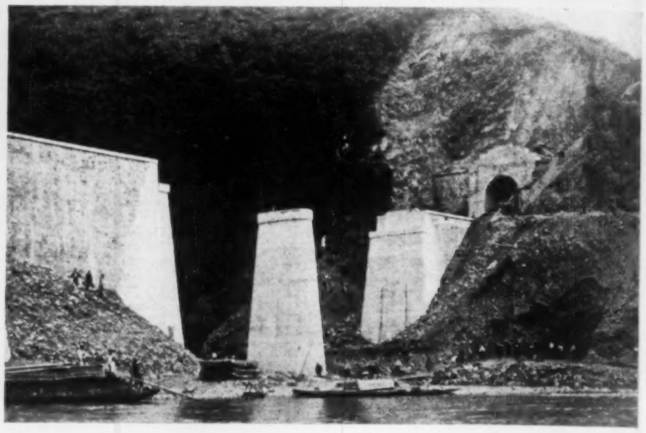


FIG. 1. SOUTH CHINA, SHOWING CANTON-HANKOW RAILWAY

One-third of this remaining section, covering a stretch of 75 miles from Lochang to Chenchow over the provincial divide, is perhaps the most difficult of the whole system, necessitating heavy rock cuts, tunneling, and the construction of extensive retaining walls. The original location of this section, which was made by British engineers of the Canton-Hankow Railway Company, required the construction of some 60 tunnels. Subsequent studies have suggested many improvements, and the line now adopted was located by Y. C. Lee and P. S. Liu, the present district engineers, who placed a part of the line on the Kwangtung side further out along the upper course of the North River, thus greatly diminishing the amount of tunneling at the expense of some increase in the quantity of protection work. Final location calls for 15 tunnels in this section, the longest one being 984 ft through hard rock.

The rock formation is mainly composed of good limestone, either exposed or covered with a few feet of earth. Most of the work of rock cutting is done with air-compressor sets and dynamite. On account of the steep natural side slopes along the river, which make the transportation of these machines exceedingly difficult, only light-weight, portable compressors can as a rule be used. In many instances, these compressors are mounted on small boats that move up and down the river as required.



PIER AND ABUTMENTS FOR RIVER CROSSING
Some of the Piers Are 110 Ft High

The construction of this section of 75 miles is very much handicapped by the inconvenience of transportation, for beyond Lochang the North River flows through deep gorges in the mountain ranges, and there are only broken paths on the steep hillsides close to the river. The river is extremely shallow in dry seasons, and within 25 miles north of Lochang there are no fewer than 18 rapids. Small boats with a draft of 18 in. can scarcely go over these rapids, and they not infrequently meet with disaster. On the north side of the divide, the mountain ranges are more scattered and there is not even a water course like the North River.

DEEP ROCK CUTTING ON A STEEP SLOPE

Thus the transportation of men and materials is exceedingly difficult, whether by land or by water. As the nature of the work requires a great deal of manual labor, it is estimated that not less than 35,000 men should be employed. Usually the contractors have to hire and bring them in from some distance and then provide them with lodging places and an ample supply of food, which constitutes another difficult problem. As the streams are shallow, with solid rock bottoms and high banks, reinforced concrete arches are most suitable from both engineering and esthetic points of view. In certain cases 30- and 40-m (100- to 130-ft) reinforced concrete arches are used to advantage, and in other instances steel spans with piers 110 ft high are not infrequent.

Air Compressors at Work
Rock Formation Is Mostly Good Limestone

From the scenic point of view, this stretch of country is exceedingly beautiful, with its deep gorges, rapids, forests, waterfalls, and rock caves. These features, however, only presented difficulties from an engineering standpoint. The accompanying illustrations show the work proceeding amid picturesque surroundings.

WORK STARTED AT BOTH ENDS

In order to complete this important line within as short a period as possible, construction work was also started from the Chuchow end during the latter part of 1933. This northern section from Chuchow to Chenchow, covering a distance of 175 miles, goes over rolling country and is much easier from an engineering point of view. In this stretch, there are three major bridges—over the Lo Ho, the Mi Ho, and the Lei Ho, all of which are tributary to the Hsiang Ho. The Lo Ho crossing consists of four 147-ft through trusses and seven 59-ft deck girders; that of the Mi Ho, of two 147-ft through trusses and fourteen 59-ft deck girders; and that of the Lei Ho, of four 197-ft through trusses and eight 59-ft deck girders. Work on these bridges was started in October 1934, and it is expected that it will be finished during the summer of 1935. On account of the facilities for cheap land transport and the possibility of navigation on the Hsiang Ho up as far as Hengchow, work is also being carried on from Hengchow toward the south. Rails and ties as well as locomotives and cars are being transported by water to Hengchow in order to push work from the middle. The construction of this middle section, from Hengchow to Chenchow, is somewhat facilitated by the presence of a good parallel highway. It is expected that work will be prosecuted rapidly and that through traffic from Canton to Hankow will be inaugurated early in 1936.

Bridge and Tunnel Under Construction, North River

A Short Tunnel Section
Final Location Calls for 15 Tunnels Between Lochang and Chenchow

The section of the line from Chuchow south to the Kwangtung border was located first by British engineers in early years and relocated later by C. J. Carroll, M. Am. Soc. C.E., an American engineer. The early location used 1 per cent maximum gradient, which Mr. Carroll reduced to 0.7 per cent in his relocation. Much greater diversity of opinion on the subject of maximum grades is expressed about a 37-mile stretch of the mountainous country on and near the provincial boundary. Several surveys were run during early days. Among such proposed lines, some of which involved prohibitive costs, the one known as the Dees' Line seems to have received most attention. Mr. Dees, a former British engineer of the northern section of the Canton-Hankow Railway, located the line along the Pei Sha Creek, with 1 per cent maximum gradient. In 1931, two surveying parties were sent out to make comparative studies of a 0.7 per cent maximum grade line following the Tien Tow Valley instead of a 1 per cent maximum grade following the Pei Sha. These surveys indicated that the proposed new location would necessitate sharp and long curves, much support and protection, greater length, and greater cost of construction.

It was decided that the question of maximum gradient should be considered in relation to the whole system, as well as to local significance. Thus a joint conference of the three sections of the line—namely, the northern and southern sections, both of which were under operation, and the Chu-Shao section, under construction—was held in Nanking early in 1933, to discuss this question as well as other important technical problems common to all. It was decided that a maximum grade of 0.7 per cent and curvature of 300-m (985-ft) radius should be fixed for the section from Chuchow to Chenchow, and that a maximum grade of 1.5 per cent with compensation and sharper curvature might be allowed for the section from Chenchow to Lochang when necessary, subject to the approval of the Ministry of Railways. Final location surveys over this difficult section have been completed for a line following partly the Dees' Line but with broken 1 per cent grades without compensation for lengths of slightly over a mile on both sides of the divide. The use of this grade is confined to a distance of 12 miles just north of the provincial border.

CONSTRUCTING RAILROAD PIERS IN CIRCULAR COFFERDAMS, MI RIVER

TYPICAL REINFORCED CONCRETE BRIDGE OVER SHALLOW STREAM

FOREIGN MATERIALS USED

In accordance with the notes exchanged between the Chinese and the British governments in September 1930, specifying that "all orders for materials required and purchased abroad out of these funds themselves, including bridges, locomotives, rolling stock, rails, and other equipment will be placed in the United Kingdom of Great Britain and Northern Ireland," all orders for such items as rails and fittings, bridges, and construction plant for the whole 251-mile section were sent out by the Ministry of Railways. This agency functioned through the Chinese Government Purchasing Commission in London during 1933 and 1934. All rails and fittings are of Chinese National Standard. The rails weigh 43 kg per meter—equivalent to 85 lb per yd—and are 12 m (39.4 ft) in length. Bridges of various spans are of standard design of Cooper's E-50 loading prepared by the Ministry of Railways. Locomotives and cars for both passenger and freight service were also ordered. All locomotives are of a new 4-8-4 type with a tractive effort of 17,500 kg, (38,587.5 lb) capable of attaining a speed of 80 km (49.7 miles) per hr on level track, and of hauling 1,000 metric tons (1,102 U. S. tons) at a speed of 25 km (15.5 miles) per hr on a 1 per cent up grade. This will be the standard type of locomotive to be used on the Canton-Hankow Railway for some time to come.

This 251-mile section requires some 700,000 ties, a good part of which are of creosoted Douglas fir from Canada, of 6 in. by 9 in. by 8-ft Australian hardwood, and of Jarrah wood, 5 in. by 9 in. by 8 ft. Ties made of Douglas fir are treated with 50 per cent pure creosote and 50 per cent petroleum at 7 lb absorption per cubic foot. Tie plates of Chinese National Standard are used under these ties.

In view of the limited funds available for the completion of this important line, it is desired to make a minimum estimate on the work, so that the line may be completed with the available resources, if necessary leaving all the less important or less urgently needed work to be done after operation has commenced. Thus a well-constructed railway with permanent structures of standard strength is required, and temporary buildings and shops and equipment for immediate use may also be a necessity. Since there are sufficient funds for foreign materials, steel structures are sometimes used for crossings where concrete bridges might otherwise prove more advantageous or economical. Station sidings, loops, and yards will be provided for immediate use, with full reservations of land for further expansion.

An estimate based on previous surveys is given in Table I. Certain revisions in the price of materials and labor have been taken into account.

TABLE I. ESTIMATE OF CONSTRUCTION COST
Chuchow-Lochang Section, Canton–Hankow Railway (251 Miles)

ITEM	CHINA FUND IN DOLLARS	LONDON FUND IN POUNDS STERLING
Excavation and earth work	$10,759,100	.....
Retaining walls, etc.	2,132,100	.....
Tunneling	2,398,300	.....
Masonry bridges	4,895,500	.....
Steel bridges	780,000	£170,000
Culverts	1,853,900	.....
Right-of-way protection	35,850	.....
Telephone and telegraph	298,700	10,000
Signal system	119,500	.....
Ties	3,624,900	.....
Rails	....	329,120
Special track	20,000	28,000
Fittings	....	87,500
Tools	20,000	1,000
Track work	1,129,200	.....
Temporary structures	566,900	3,000
Stations and structures	1,151,000	20,500
Engine sheds and equipment	125,000	120,000
Locomotives	....	240,800
Passenger coaches	....	192,500
Freight cars	....	300,000
Locomotive cranes	....	10,000
Maintenance during construction	290,000	.....
Surveying and instruments	215,250	5,000
Land	1,135,000	.....
General expenses	3,000,000	.....
Contingencies	961,000	127,580
Total	$35,511,200	£1,645,000

The completion of the Canton-Hankow line will undoubtedly be of great importance in the development of China, providing the only inland route between two cities with populations of 950,000 and 1,500,000, respectively.

Design of Valve Houses at Boulder Dam

Exigencies of Location Necessitate Unusually Heavy Walls and Roof

By Alfred R. Golzé
and Riley T. Cass
Juniors American Society of Civil Engineers
Respectively, Assistant Engineer and Junior Engineer, U. S. Bureau of Reclamation, Denver, Colo.

Perched on almost inaccessible benches excavated in the sides of a canyon a thousand feet deep, the valve houses at Boulder Dam will be subject to danger of excessive movement from earthquake shock as well as damage from rock spalling off the cliffs. The concrete-producing facilities at the dam made the use of steel uneconomical. It was therefore decided to built the structures of reinforced concrete, with inverted L-shaped, rigid-frame construction for front walls and main roof. For the purpose of further protection, an outer or secondary roof of steel rails embedded in concrete was constructed on concrete pedestals resting on the main roof of each valve house. It is expected that the outer roof by deflecting will minimize serious damage to the valve houses due to falling rock. The column analogy method was used by Messrs. Golzé and Cass in designing the rigid frame. The various steps in the process appear here in sufficient detail to make this interesting design clear to the reader without burdening him with every particularity of the problem.

Control of the flood waters of the Colorado River is one of the chief functions of the Boulder Canyon project of the U. S. Bureau of Reclamation. Other major functions are the control of the river for navigation, the generation of electrical power, and the furnishing of water for irrigation and domestic purposes, as required. Control of flood waters will be accomplished chiefly by lowering the reservoir level behind the dam in the spring of the year in advance of the customary seasonal floods. The amount the reservoir will be drawn down will depend on the snowfall and other pertinent conditions of the watershed.

To accomplish a relatively rapid discharge of water from the reservoir, the Bureau of Reclamation has designed two batteries of 84-in. needle valves, one on each side of the canyon, housed in concrete structures known as the valve houses of the canyon wall outlet works. The general location of the valves and their connection with the reservoir are shown in Fig. 1, marked *A*. Each 84-in. valve will discharge an average of about 3,800 cu ft per sec, providing an average total discharge of 46,000 cu ft per sec, which is considerably below the flood flows that occurred before the construction of the dam, and well within the capacity of the lower river channel. It is expected that it will be necessary to use all 12 valves only when a heavy run-off is anticipated, as operation of the power plant and of the needle valves in the lower tunnel plugs, for irrigation, will ordinarily lower the reservoir during the winter months.

The valve houses were constructed in the winter and spring of 1935 on a bench excavated out of the canyon walls 800 ft downstream from the dam and 160 ft above the normal water surface of the river. Besides the six 84-in. needle valves, each house contains an equal number of 96-in. emergency Paradox gates. These gates are shut when the needle valves are not in operation, thus relieving the valves of the pressure head of the reservoir. They are intended also to provide an emergency shut-off in case a valve fails or is damaged. The emergency gates are embedded in massive concrete blocks and the reinforcement is carried back into the concrete filling of the penstock tunnels to ensure that none of the thrust of the water against the closed gates will be carried into the frame of the valve buildings.

In each building there are six valves and six gates spaced 25 ft on centers. The dimensions of the buildings are further increased by the angle of emission of the valve penstocks from the canyon walls, which is 70 deg with the building face on the Nevada side and 60 deg on the Arizona side. As finally designed, the buildings are each 40 ft wide and 70 ft high. The building on the Arizona side is 206 ft long; that on the Nevada side is 190 ft long. Inside each valve house there is a 30-ton crane with a 10-ton auxiliary for shifting equipment.

The first major problem to be worked out in designing the valve houses was to determine the type of structure and make a stress analysis of the frame. As the floor and back wall would be built solidly against rock, the cross-sectional frame to be designed and analyzed consisted of an inverted L-shaped bent. Three different designs were considered for the frame: one entirely of structural steel, one of structural steel roof beams on concrete columns, and one entirely of reinforced con-

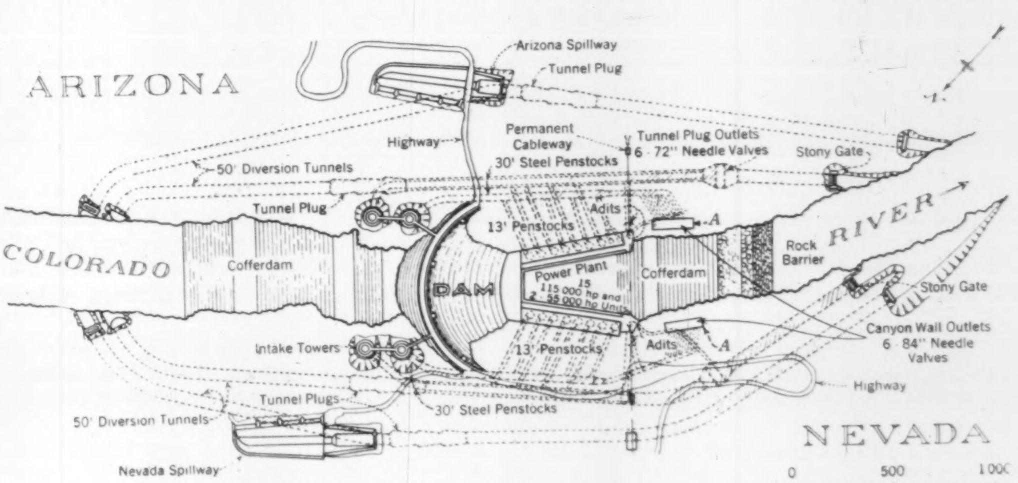
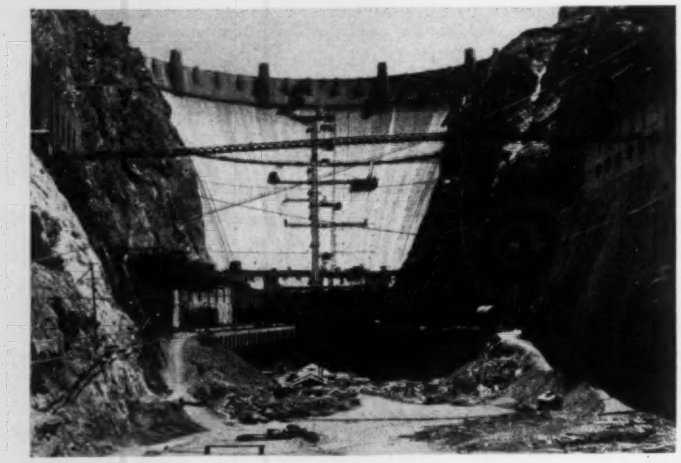


Fig. 1. Plan of Boulder Dam and Appurtenances

crete. Calculations were made to determine the most economical type using the maximum roof loads expected plus an allowance for crane and wind loads. The types using steel were eliminated because the unsupported height of the front wall and the long span of the roof beams carrying heavy loads made this material uneconomical as compared with concrete in place. The price of the latter was the deciding factor in selecting a reinforced-concrete rigid frame for the buildings.



DOWNSTREAM FACE OF BOULDER DAM
Showing Valve Houses High on Canyon Walls at Extreme Right and Left, and Power House Under Construction in Lower Center

In making the calculations, use was made of one of the relatively new tools available to the engineering profession for analysis, the column analogy method developed by Hardy Cross, M. Am. Soc. C.E. The varying moment of inertia of the L-shaped frame was responsible for the decision to use this method. With haunched roof beams and a battered front wall, analysis of the rigid frame by any other method would have been difficult, involving considerably more work; or else the design would have had to be altered to make the structure statically determinate and correspondingly more costly.

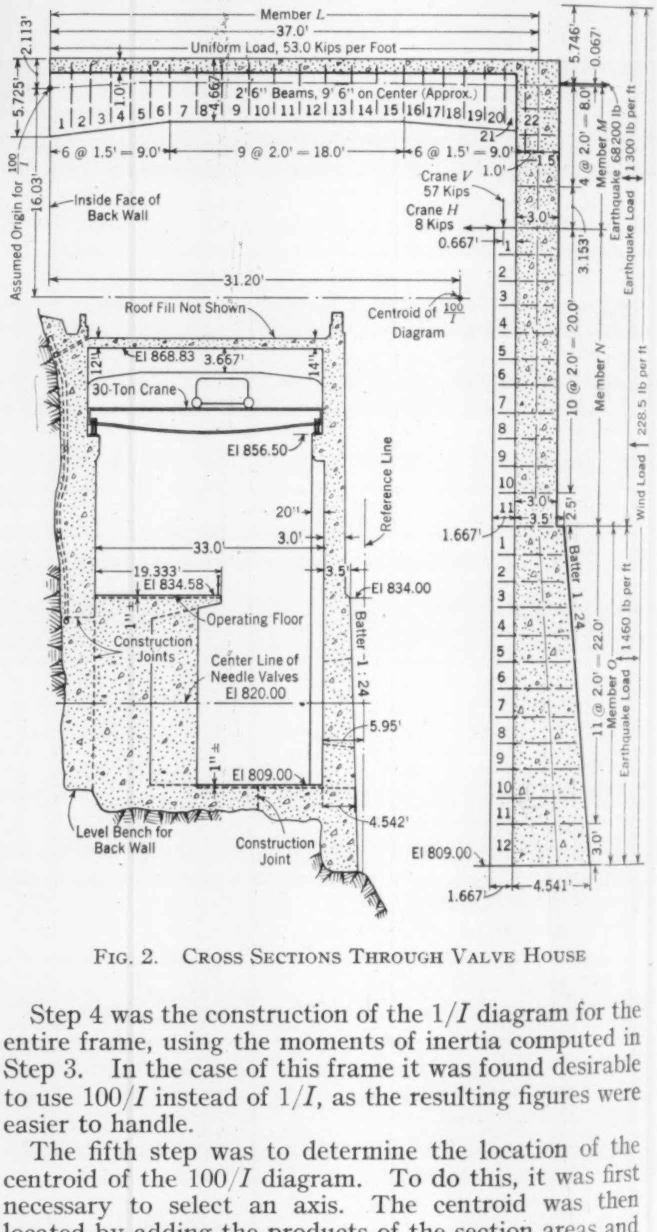
Because of the superiority of the column analogy method over other possible methods of solving this type of problem, a detailed explanation of it will be given to illustrate its application to an indeterminate structure. No attempt will be made to develop or explain the theory of column analogy, as that has been done very satisfactorily in Bulletin No. 215 of the University of Illinois Engineering Experiment Station.

ANALYSIS BY COLUMN ANALOGY METHOD

For convenience the analysis was divided into eight consecutive major steps with four subdivisions. The first step was to determine approximately the size of the members of the frame. In this case a study was made of available tables of haunched beams and a size selected as being most suitable for the loads expected. The thickness of the front wall was determined by statics, assuming possible loads acting on the wall as a column. The shape of this wall was fixed on the outside by architectural considerations and on the inside by the location of the crane. The column and beam so selected were then put together, and the resulting frame was analyzed as will be outlined. All connections were assumed to be rigid.

The second step was the dividing of the frame into members and sections. The roof beam was considered as one member and the front wall as three members, the divisions being made at changes in cross section. Each member was then divided into sections. In this type of analysis the number of sections taken is an index of the accuracy of the work, as the bending moment is found for each section. In this case 50 sections were taken to trace accurately the moments in the frame due to the various loadings. For a simpler frame and fewer loads not as many sections would be required. The arrangement of the members and sections adopted for use in the analysis is given in Fig. 2.

Step 3 was the computation of the physical properties of each section. This was done in two parts: First, the area of each section in the plane of the cross section of the building was determined; second, the moment of inertia of each section was computed about its own centroid. Before the moment of inertia could be computed, it was necessary to select a width for the frame. The advantages of using the chosen width of 28 ft will be discussed later.



Member L
37.0'
Uniform Load, 53.0 Kips per Foot
2.113'
5.725'
1.0'
4.667'
2'6'' Beams, 9' 6'' on Center (Approx.)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
21
22
6 @ 1.5' = 9.0'
9 @ 2.0' = 18.0'
6 @ 1.5' = 9.0'
1.5'
1.0'
5.746'
0.067'
4 @ 2.0' = 8.0'
Member M
Earthquake 68 200 lb
Earthquake Load 1 300 lb per ft
Crane V 57 Kips
Crane H 8 Kips
3.0'
0.667'
3.153'
Assumed Origin for $\frac{100}{I}$
16.03'
Inside Face of Back Wall
31.20'
Centroid of $\frac{100}{I}$ Diagram
Roof Fill Not Shown
El 868.83
3.667'
12''
14''
30-Ton Crane
El 856.50
Reference Line
10 @ 2.0' = 20.0'
Member N
Wind Load 228.5 lb per ft
20''
3.0'
33.0'
3.5'
2.5'
1.667'
19.333'
El 834.58
El 834.00
Operating Floor
1''
Construction Joints
Center Line of Needle Valves El 820.00
Batter 1 : 24
5.95'
El 809.00
4.542'
Level Bench for Back Wall
Construction Joint
11 @ 2.0' = 22.0'
Member O
Earthquake Load 1 460 lb per ft
3.0'
4.541'

FIG. 2. CROSS SECTIONS THROUGH VALVE HOUSE

Step 4 was the construction of the $1/I$ diagram for the entire frame, using the moments of inertia computed in Step 3. In the case of this frame it was found desirable to use $100/I$ instead of $1/I$, as the resulting figures were easier to handle.

The fifth step was to determine the location of the centroid of the $100/I$ diagram. To do this, it was first necessary to select an axis. The centroid was then located by adding the products of the section areas and their distances to this assumed axis and dividing the resulting total by the total area of the $100/I$ diagram. It was found desirable to place the origin of the assumed axis at the junction of the back wall with the center of the roof beam, but it could have been placed at any point that would tend to simplify the arithmetic. A correction for the centroid was applied at once to the computations by deriving new coordinate values for each section. Professor Cross prefers to apply this correction after making his subsequent computations, but it was found that for an irregular frame with a number of loads, immediate application of the correction facilitated the subsequent work. At this time, for use in Step 7, the values of $I_x = \Sigma ax^2$ and $I_y = \Sigma ay^2$ were computed. Here a is the area for each section, as computed in Step 3, and x and y are the coordinates of each section to the centroid.

The sixth step was the loading of the $100/I$ diagram with the statical moment identified as m_s. This was done by taking each member separately, applying the external load to it, and computing the resulting bending moment for each section as if the member were a cantilever beam. A simple beam assumption would have answered just as well. The loads on the roof produced no statical moment in the front wall and vice versa. Multiplying m_s by the area of the section gave the total load, P, on each section of the $100/I$ diagram. Multiplying P by x and y gave the moments known as M_x and M_y. The values thus found for P, M_x, and M_y, were separately totaled for the 50 sections, and M_x and M_y corrected for dissymmetry in the manner advocated by Professor Cross to give M'_x and M'_y. Similarly, I_x and I_y, found in Step 5, were corrected to give I'_x and I'_y.

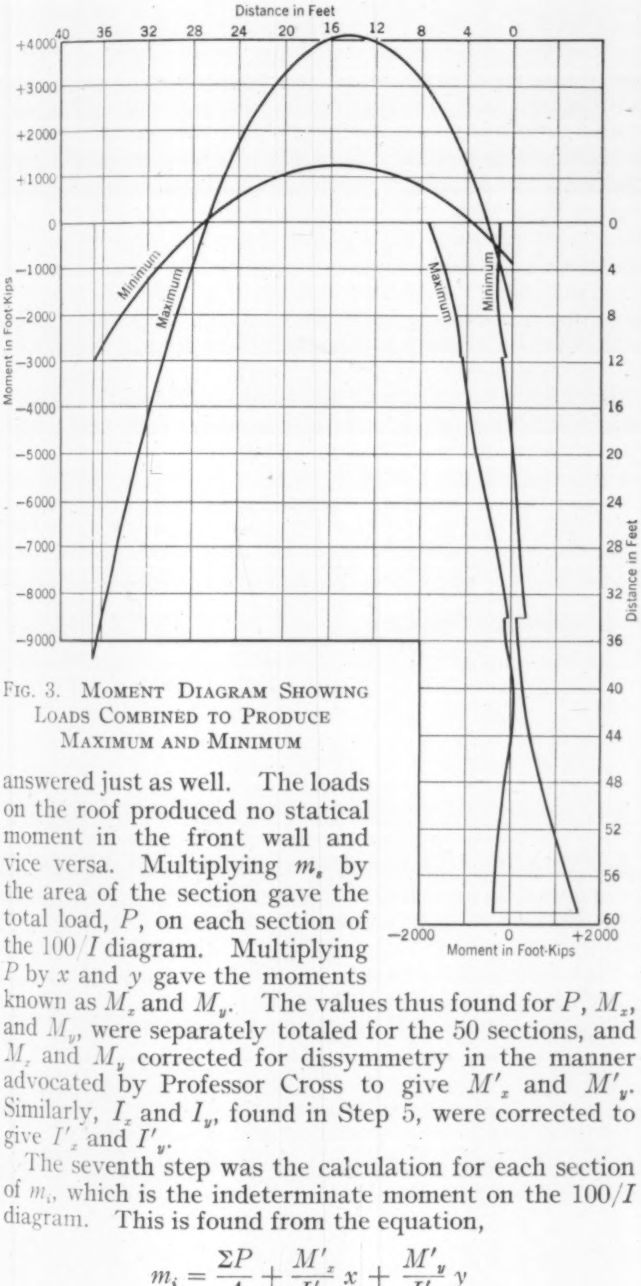
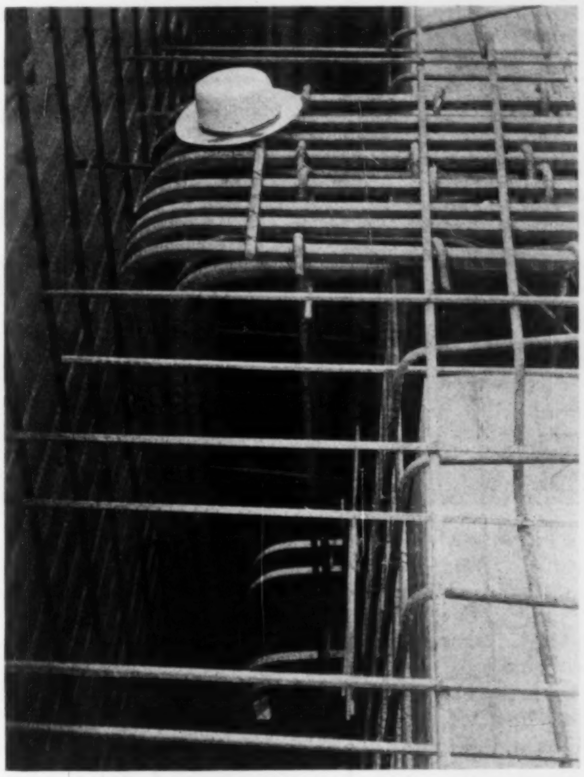


FIG. 3. MOMENT DIAGRAM SHOWING LOADS COMBINED TO PRODUCE MAXIMUM AND MINIMUM

The seventh step was the calculation for each section of m_i, which is the indeterminate moment on the $100/I$ diagram. This is found from the equation,

$$m_i = \frac{\Sigma P}{A} + \frac{M'_x}{I'_x}x + \frac{M'_y}{I'_y}y$$

in which ΣP is the sum of the P values for each section, and consequently the total load on the diagram; A is the total area of the diagram and equal to the sum of the areas, a, for each section; M'_x and M'_y are the total moments of P obtained in Step 6, corrected for dissymmetry; I'_x and I'_y are as computed in Step 5 and corrected in Step 6; and x and y are the coordinates of the sections to the centroid as computed in Step 5. This equation can be reduced to the form of $m = a + bx + cy$ for any given load on the frame, where a, b, and c are all constants, and only x and y vary for each section.



MAIN ROOF-BEAM STEEL AT FRONT WALL OF VALVE HOUSE
Reinforcing Rods Bent Down Into Wall to Develop Fixed-End Conditions Used in Design. In Rear Wall, Anchor Rods Were Embedded in the Cliff Rock at Frequent Intervals to Provide Movement of House and Cliff as a Unit During Earthquakes

For the eighth and final step of the column analogy method, the actual moment, M, on the actual frame is obtained from the relation, $M = m_s - m_i$. This bending moment, M, was computed for each of the 50 sections and plotted on cross section paper as a check. Any irregularity in the plotted curve would be an indication of a possible error in the computations. This completed the analysis for any one given load.

The eight steps may be summarized as follows:

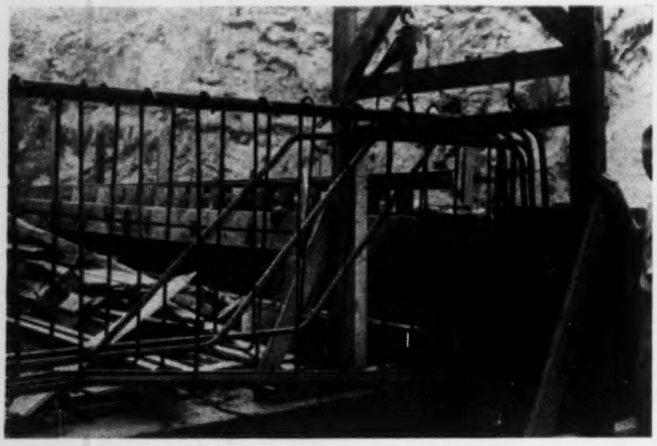
1. Select the size of frame members by approximation.
2. Divide frame members into sufficient sections to derive a reasonably accurate moment curve.
3. Compute cross-sectional areas and moments of inertia.
4. Construct $1/I$ diagram.
5. Locate centroid of $1/I$ diagram and compute correction.
    a) Compute $I_x = \Sigma ax^2$, and $I_y = \Sigma ay^2$ for use in Steps 6 and 7.
6. Load $1/I$ diagram with statical moment, m_s.
    a) Multiply m_s for each section by its corresponding area to derive P for each section.

b) Multiply P for each section by the corresponding x and y coordinates to derive M_x and M_y.

c) Sum up separately P, M_x, and M_y and correct M_x, M_y, I_x, and I_y for dissymmetry to get M'_x, M'_y, I'_x, and I'_y.

7. Solve $m_i = \frac{\Sigma P}{A} + \frac{M'_x}{I_x} x + \frac{M'_y}{I'_y} y$ for each of the sections.

8. Solve $M = m_s - m_i$ for each of the sections and plot.



REINFORCEMENT FOR HALF OF ROOF BEAM BEING LOWERED INTO PLACE

Beam Reinforcing Was Wired Together Before Placing in the Forms

Repeat these eight steps for each load separately and then combine.

The foregoing may appear complicated but it is surprising how well it works out in practice. All the steps can be tabulated and the work of computing the moments for an involved framework reduced to a series of slide-rule or computing-machine operations. The analysis described was carried through five times for each of the loads acting on the frame of the valve houses before the final dimensions were determined.

The loads considered as acting on the frame were a uniform combined dead and live load on the roof of 1,840 lb per sq ft, a wind load of 10 lb per sq ft on the front wall, a horizontal crane thrust of 8,000 lb (10 per cent of capacity) acting in either direction, and a vertical crane load of 44,800 lb (50 per cent of capacity plus 25 per cent for impact). A temperature correction was incorporated into the column analogy analysis in a manner similar to that suggested by Professor Cross. The possibility of earthquake stresses was given due consideration by assuming 10 per cent of the gravity weight of the frame to act horizontally and in both directions. The application of this load to the frame is shown in Fig. 2.

In studying the application of earthquake forces it was necessary to consider two separate cases—one in which the back wall was doweled to the adjacent rock to prevent independent movement of the building frame, and the other in which this was not done and the frame was allowed to act independently of the rock. In studying the first case, the same inverted L-shaped frame was used as for all the other loads, but for the case where the back wall was free it was necessary to add another leg to the frame, giving it the shape of an inverted "U." Both analyses were made by column analogy. The bending moments for the roof beam and front wall averaged much less when the back wall was considered to be fastened to the rock than when it was considered to be free. In addition it was found that, for the U-shaped frame, tension of such magnitude would be developed that reinforcement throughout the back wall would be required. As the amount of steel needed for doweling the back wall would be less than that needed for reinforcement, doweling was decided on. This had the additional advantage of reducing the moments in the rest of the frame.

Bending moments computed for each load were summarized by inspection to find the maximum and minimum, as shown in Table I. In this table every other section has been omitted for brevity. The last two columns were plotted graphically to produce Fig. 3. The terms maximum and minimum as used here are purely relative. The values shown in Table I, under the heading "Maximum," were obtained by combining

TABLE I. SUMMARY OF BENDING MOMENTS, IN FOOT-KIPS

	Roof Loads		Crane Loads				Earthquake Effect		Total Moment	
Section	Dead	Live	Vert.	Hor.	Wind Load	Temperature Effect	Back Wall Doweled	Back Wall Not Doweled	Maximum	Minimum
L-1	− 3,010	− 5,590	− 13	∓ 22	+19	+76	∓ 145	+ 1,033	− 8,780	− 2,748
3	− 1,890	− 3,510	− 11	∓ 16	+14	+68	∓ 97	+ 938	− 5,524	− 1,695
5	− 910	− 1,590	− 8	∓ 10	+ 9	+60	∓ 60	+ 833	− 2,578	− 771
7	− 30	− 70	− 4	∓ 5	+ 3	+51	∓ 20	+ 726	− 129	+ 49
9	+ 740	+ 1,360	+ 1	∓ 2	− 3	+40	∓ 16	+ 573	+ 2,159	+ 719
11	+ 1,190	+ 2,210	+ 6	∓ 9	− 9	+30	∓ 52	+ 421	+ 3,497	+ 1,120
13	+ 1,390	+ 2,680	+ 12	∓ 16	−15	+19	∓ 88	+ 258	+ 4,205	+ 1,271
15	+ 1,280	+ 2,370	+ 17	∓ 22	−21	+ 8	∓ 124	+ 105	+ 3,821	+ 1,113
17	+ 980	+ 1,810	+ 22	∓ 28	−25	0	∓ 142	− 21	+ 2,982	+ 785
19	+ 518	+ 964	+ 27	∓ 32	−29	− 8	∓ 159	− 145	+ 1,700	+ 290
21	− 105	− 196	+ 31	∓ 36	−32	−16	∓ 164	− 279	− 549	+ 126
22	− 415	− 772	+ 34	∓ 38	−34	−20	∓ 176	− 338	− 1,455	− 167
M-1	− 530	− 980	+ 42	∓ 32	−33	−21	∓ 175	− 298	− 1,771	− 281
3	− 460	− 860	+ 70	∓ 6	−13	−19	∓ 64	− 371	− 1,422	− 320
5	− 380	− 710	+102	∓ 24	+ 5	−18	∓ 41	− 361	− 1,173	− 208
N-1	− 290	− 540	−141	∓ 34	+14	−16	∓ 88	− 339	− 1,109	− 154
3	− 220	− 420	−114	∓ 28	+23	−15	∓ 139	− 302	− 936	− 30
5	− 160	− 290	− 86	∓ 22	+29	−13	∓ 171	− 255	− 742	+ 62
7	− 90	− 170	− 58	∓ 17	+32	−12	∓ 181	− 178	− 528	+ 140
9	− 20	− 40	− 30	∓ 11	+30	−11	∓ 173	− 81	− 285	+ 194
11	+ 50	+ 90	− 1	∓ 5	+24	− 9	∓ 136	+ 47	− 101	+ 305
O-1	+ 10	+ 20	− 15	0	+19	− 9	∓ 107	+ 115	− 121	+ 156
3	+ 60	+ 100	+ 2	∓ 6	+ 8	− 8	∓ 40	+ 281	+ 6	+ 216
5	+ 100	+ 180	+ 19	∓ 11	− 8	− 7	∓ 50	+ 437	+ 24	+ 360
7	+ 140	+ 270	+ 38	∓ 17	−26	− 6	∓ 159	+ 634	− 68	+ 624
9	+ 190	+ 350	+ 56	∓ 23	−48	− 5	∓ 293	+ 850	− 179	+ 912
11	+ 230	+ 430	+ 74	∓ 30	−61	− 4	∓ 450	+ 1,096	− 315	+ 1,214
12	+ 260	+ 490	+ 87	∓ 34	−78	− 3	∓ 557	+ 1,257	− 412	+ 1,428

with the roof dead-load moments the other moments that would give the largest algebraic total. The "Minimum" values were obtained by adding to the roof dead-load moments, all the moments acting in the direction opposite to those that were included in the "Maximum" totals. For member "O" this routine was reversed to produce a smooth moment curve, but this change was relatively unimportant, as the design of the reinforcing steel was based on the largest moments, both "Maximum" and "Minimum." The moments shown under the heading "Back Wall Not Doweled" are listed for comparison only, and are not included in the totals. In Fig. 3 it will be noticed that the curve of maximum moments represents values greater than those represented by the curve of minimum moments in all cases except for the battered part of the front wall. The greatest values for the bending moments, shown in Fig. 3 for each section, were used to design the reinforcing steel, which was selected with the customary regard for shear and bond and involved no unusual difficulties.

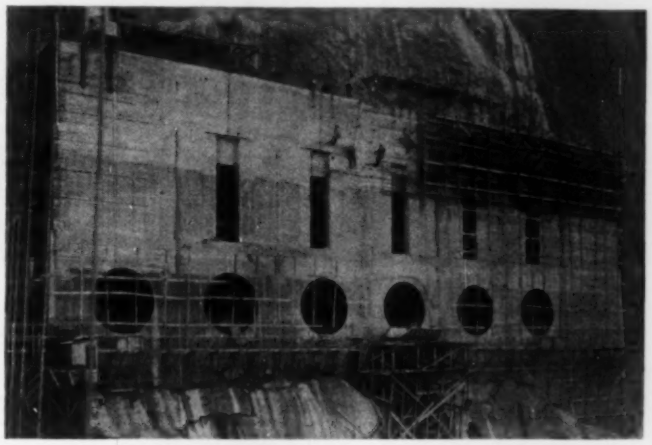
It is of interest to note the flexibility of the column analogy method in its application to a frame of the type here described. The variable moment of inertia was relatively easy to handle and in addition it was possible to include a thickness of frame equal to a section of the valve house approximately 28 ft in length, as shown in the sections of Fig. 3. The 28-ft thickness was automatically determined by the location of contraction joints. The joints were spaced at this distance to provide amply for shrinkage and for changes in the concrete resulting from the changes in temperature of approximately 100 deg that occur at Boulder Dam. The contraction joints are responsible also for the greater width of roof beams required to permit each half-beam to be reinforced separately, since the reinforcing steel could not be carried across the joint. The joints were keyed together mechanically so that each half of the beam would deflect the same amount, and the two halves would tend to act as a unit. At each contraction joint in the front wall, a large column or pilaster was provided, keyed like the roof beams.

In using the 28-ft width for the $100/I$ diagram, the total moments as found for the roof would apply to two small beams and to two halves of one large beam. In designing the reinforcing steel for the roof beams, the total bending moment (Fig. 4) was considered to be distributed among the beams in proportion to their stiffness. No distribution was necessary for the front wall as it was of uniform thickness and allowance had been made for windows and orifice liners when the moments of inertia were computed. Also, in selecting the reinforcing steel care was taken to actually develop a rigid frame at the corner of the "L" and at the connections of the frame with the back wall and the floor, in order to fulfill the conditions assumed in the analysis. A detail of the rigid-frame reinforcement at the front-wall corner of the "L" appears in one of the accompanying photographs.

The uniform roof load used in the calculations, as previously mentioned, was 1,840 lb per sq ft. This load was a combination of 640 lb of dead load and 1,200 lb of live load. The value for live load resulted from a consideration of the shocks to which the roof might be subjected. Since the valve houses are situated on a bench on the canyon walls, it appears probable that pieces of rock may fall on the roofs as a result of weathering of the rock face. The second major problem presented in the design of the buildings was how to guard them within reasonable limits against serious damage.

The same problem was encountered in designing the roof of the power plant at the foot of Boulder Dam. Here it was solved by placing alternate layers of gravel and sand on the roof, above and below a slab of reinforced concrete. Impact forces resulting from falling rocks will be absorbed partly by these materials and partly by deflection of steel roof trusses.

In the valve houses, however, no deflection of the roof beams is possible owing to the rigidity of the reinforced concrete of which they are constructed. To provide the necessary deflection and at the same time protect the structures, a secondary roof slab, made of old railroad rails embedded in concrete, was placed above the main roof. The secondary slab is supported on 15-in. pedestals resting on the main roof to provide a space for the rails to deflect without touching the main slab. To prevent overloading the main roof below, the pedestals are constructed of concrete designed purposely weak by the inclusion of calcined diatomaceous earth so that they will fail under a total load of 100,000 lb. On top of the secondary slab is a foot of fine gravel. Part of the kinetic energy of a falling rock will be absorbed in the gravel and the remainder will be expended in deflecting the rails and crushing the concrete slab. In making the design a rock of 2,000 lb falling freely 200 ft was used as a basis. It was decided that it would be uneconomical to consider a larger rock or greater height of fall because the interest on the investment for more effective protection would be greater than the possible cost of repair some years hence.



Nevada Valve House Nearing Completion
Construction Under Difficulties

Although this protective system will bring concentrated loads to the main roof slab of 100,000 lb, the column analogy method of analysis did not make possible the inclusion of a concentrated roof load on a 28-ft width of frame. A uniform load of 1,200 lb per sq ft was found to give greater bending moments than a 100,000-lb concentrated load for a rigid frame the width of one beam. Using a uniform load of 1,200 lb per sq ft over the entire 28-ft width has resulted in a roof structure fully capable of carrying a concentrated load of 100,000 lb.

The valve houses were designed under the supervision of J. L. Savage, M. Am. Soc. C.E., chief designing engineer; of B. W. Steele, Assoc. M. Am. Soc. C.E., senior engineer of dams; and of W. E. Blomgren, engineer, all of the design staff of the U. S. Bureau of Reclamation in Denver, Colo. The preliminary work of L. W. Bartsch, an assistant engineer of the Bureau, was of great assistance in determining the final design. The chief engineer of the Bureau is R. F. Walter, and the commissioner is Elwood Mead, both Members Am. Soc. C.E.

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RIGID-FRAME BRIDGE BUILT BY WAYNE COUNTY, MICHIGAN, IN 1934
Carries Six-Mile Road Over Middle Rouge Parkway. Clear Span, 60 Ft; Roadway, 40 Ft; Two Sidewalks, Each 6 Ft

Comments on Rigid-Frame Bridges

A Word of Caution Regarding Some Recent Tendencies in Design

By ARTHUR G. HAYDEN
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DESIGNING ENGINEER, WESTCHESTER COUNTY PARK COMMISSION, WHITE PLAINS, N.Y.

SINCE its advent fifteen years ago, the rigid-frame bridge has made for itself a notable place in the field of design for special conditions, particularly for limited headroom. As the engineer who is mainly responsible for the origin of this type, Mr. Hayden has followed its development with particular interest. Recent tendencies, he observes, point toward a departure from the early simplicity of design that contributed to the economy of this type of structure. He emphasizes such elements as footings on soil and rock, provision for a variety of secondary stresses, and proportioning of the concrete sections. All his observations bear the stamp of intimate experience. In view of the probable increase in the volume of short-span bridge construction, particularly for grade separations, this discussion and restatement of simple principles is timely.

RIGID-frame bridge construction in the United States has advanced rapidly since the first bridges of this type were built in Westchester County, just north of New York City, in 1922. Because the Westchester County Park Commission pioneered in this structural development, it has acted as adviser to many outside engineers and highway departments. Frequently design calculations and plans have been submitted to it for examination and comment. Some constructive observations, based on such reviews, form the basis of this article.

A rigid-frame bridge is an arch-like structure; in fact it is an arch of peculiar shape, subjected to very heavy bending moments, particularly where the axis makes a sharp bend. Almost invariably the true arch is definitely fixed by massive abutments, or definitely hinged at the abutments and sometimes at the crown as well. The rigid-frame bridge need not be either definitely fixed at its supports or definitely hinged; in fact, economy is lost in trying to make it conform to one or another of the types recognized in arch construction, and there is no reason for attempting it.

FOOTINGS OF SEVERAL TYPES

Consider first the rigid-frame structure on a rock foundation. In a few cases designers have been carried along by association of ideas to the concept of a fixed arch. Thus mislead, they have adopted the expensive expedient of drilling deep holes into the rock and of setting long anchor bolts extending upward into the legs of the frame in order to make the frame fixed at its ends.

In some instances stresses have been analyzed for "fixed-end" conditions but without making provision, by anchorage, for effecting the necessary fixity. As a result of this confusion of thought the calculated stresses have indefinite relations to the actual stresses in the structure.

When a narrow footing rests on rock, its angular movement is bound to be very small. Hence, if ties between the main reinforcing rods are used to prevent possible spalling just above the bearing surface on rock, the integrity of the structure will be just as great as when a concrete column with hooped ends rests on a similar hard surface. The detail shown in Fig. 1 (*a*) has been used for Westchester County bridges, and in no instance has there been any indication of spalling at the edges of the footing. The compressibility of the concrete itself probably accommodates the footing to the slight angular change that occurs at the rock surface.

Because the conventional arch is either fixed or hinged, there has been a strong tendency to introduce definite hinged articulation above the footing of rigid-frame bridges on earth foundations. It is true that without absolute fixity, or without definite hinged articulation, there is some uncertainty about the stresses, due to the impossibility of locating definitely the point on the base of the footing through which the resultant reaction will pass. It is certain, however, that unless the footing can be fixed at the base so that rotation is effectively prevented, the resultant reaction cannot by any possible means pass outside the base. Moreover, unless infinite soil pressure resistance is postulated, the reaction must be centered some distance in from the edge of the base. Stresses could be analyzed for extreme conditions, as for reaction points (hypothetical hinges) near one edge of the footing or the other, whichever would give the higher stresses at the particular point in the structure under consideration. It would be known for a surety that the critical stresses thus calculated could never be exceeded.

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HIGHWAY BRIDGE IN KRAPE PARK, FREEPORT, ILL.

Designed by Mogens Ipsen, Consulting Engineers. It Has a Clear Span of 70 Ft, a Roadway of 20 Ft, and One 5-Ft Sidewalk

If the structure is proportioned for these "outside" stresses and it is found that the economic loss in materials is less than the cost of hinged articulation, there is no justification for hinged construction. This is actually the case for the rigid-frame bridges built by the Westchester County Park Commission up to a span length of 80 ft. In fact, it was found that calculating stresses for assumed hinged points in any other position than near the middle of the base is an unnecessary refinement, unless the footing has to be very wide because of poor soil conditions. A typical footing with limiting soil pressures is shown in Fig. 1(*b*).

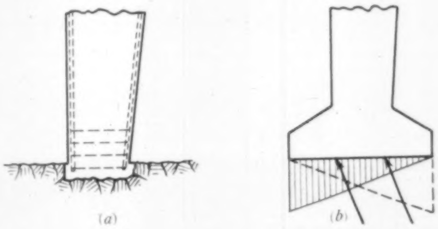

FIG. 1. FOOTINGS FOR RIGID-FRAME BRIDGES

(*a*) On Rock, Vertical Section, Showing Ties Between Main Vertical Rods in Each Face

(*b*) On Earth, with Resultant Reactions in Assumed Extreme Positions and Corresponding Soil Pressures

More uncertainty exists when the structure is on pile foundations. The grip of the concrete footings on the tops of the piles might introduce sufficient restraint to cause the resultant reaction to pass outside the base. In such a case there is little loss of economy in calculating stresses for both fixed-end conditions and hinged-end conditions and proportioning the structure for the controlling stresses. Comparisons made for Westchester County bridges again showed that for ordinary structures there is no advantage in hinged articulation even though pile foundations are used.

ACCOUNTING FOR SECONDARY EFFECTS

Possibly some confusion of thought has resulted from the design practices recommended by the Westchester County Park Commission in not allowing for certain secondary effects, among which may be mentioned restraint of side sway for unsymmetrical shape or loading; shrinkage and plastic flow of concrete; piling up of passive earth pressure; and outward movement of the footings due to yielding of the foundations. Such procedure, however, has been justified.

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GRADE SEPARATION AT DEDHAM, MASS.

Clear Span 62 Ft 3 In. with Roadway of 40 Ft and Sidewalks of 10 Ft and 5 Ft. Designers, Fay, Spofford, and Thorndike

Neglect of side sway takes on importance only if it is assumed that the roadway approach fill is so solidly packed against the abutments, that is, against the vertical legs of the frame, that it is practically incompressible, thus effectively preventing the free deformation of the structure. Tests were made on one of the early bridges built by the Bronx Parkway Commission for the Bronx River Parkway, forerunner of the Westchester County Parkways. These tests showed that the passive earth pressure developed on the back of the abutment due to flexure under loading is negligible in amount. It is inconceivable that the earth backing can prevent side sway at the knee of the frame without pronounced development of passive earth pressure on the back of the abutment, which would also prevent flexure.

It is true that if a rigid-frame bridge is loaded for only a part of its width, the unloaded part exerts restraint on the side sway of the loaded part. Some engineers have recommended that this should be taken into account in design. If this action is in reality worthy of consideration, it should be recognized that all deformations are

Courtesy, Emilio H. Baumgart, Civil Engineer

THE HERVAL BRIDGE, BRAZIL

Its Center Span of 224 Ft Is Claimed to Be the Longest for a Rigid-Frame Bridge likewise affected and current conventions for design would have to be entirely revised for many structural types. In the present instance the problem would be greatly complicated merely to provide for an improbable set of conditions. In my opinion restraint of side sway may be entirely neglected for the ordinary structures under consideration—short-span rigid-frame bridges.

In regard to the accumulated influence of all the secondary effects enumerated, it may be said that the Westchester County designers gave considerable study to the subject in early designs for their bridges. It was found by experience that simple, direct methods of design gave as good results as an exhaustive calculation including reasonable allowances for secondary effects.

STEEL RIGID-FRAME BRIDGE AT PALMER AVENUE, YONKERS, N.Y. LEFT: UNDER CONSTRUCTION; RIGHT: COMPLETED
Designed and Constructed by Westchester County Park Commission. Clear Span, About 115 Ft

DESIGN METHODS DEVELOPED

Several design procedures were evolved and tried out in the Design Division of the Bronx Parkway Commission and later in the Westchester County Park Commission. These included a modified slope-deflection method and an adaptation of the moment distribution method. Attempts were also made to reduce the problem to sets of formulas. All of them, in order that they might be used to any advantage at all, involved approximations which led to more serious error in particular cases than the neglect of the secondary effects just discussed.

This has been the experience also of other designers who have tried to apply short-cut methods, which after all resulted in little if any saving of labor. Such methods usually become quite complicated when applied to other than flat-topped frames. In some designs, where a saving in headroom was not important, considerable arching of the top of the frame was introduced for architectural effect. Neglect of this, in some of the methods tried out in practice, proved to be serious and corrections were found to be troublesome. Reduction of the method of design to a set of formulas for critical moments proved the least satisfactory. Finally, a standard practice was evolved for the county work, whereby the designer is able to sense just what he is doing at all stages of the calculation. If the work is properly tabulated and the divisions to be mechanically integrated are judiciously selected, the labor of calculation is reduced to the equivalent of any short-cut method.

PROPORTIONING OF CONCRETE FRAME BRIDGES

The experience of the past few years has made it possible to formulate more closely the preliminary proportions for final analysis. For concrete frame bridges up to a span of about 80 ft, carrying separate roadway pavement and designed for H-20 highway loading, as defined by the Association of State Highway Officials, the crown thickness in inches will be about $4 + \frac{L}{55}$, in which L is the span length in inches, that is, the distance between assumed reaction points. The thickness at the knee will be about $4 + \frac{L}{15}$. A small amount of compressive reinforcement at the crown will often permit the detailing of the steel pattern so as to maintain a wide lateral spacing of the main reinforcement—about 6 in.—throughout the frame.

Fortunately the principles of design for the skewed frame bridge have been thoroughly worked out. The method of determining the reactions was established by J. Charles Rathbun, M. Am. Soc. C.E., and is explained in the paper by Bernard L. Weiner, published in TRANSACTIONS, Vol. 96 (1932), page 1212. An adaptation of Professor Rathbun's method for calculating the reactions, made by Richard M. Hodges, Assoc. M. Am. Soc. C.E., of the Westchester County Park Commission appears in the writer's book, *The Rigid Frame Bridge*. An exact method for proportioning the sections to resist the reactions is given in Mr. Weiner's paper, and a simpler approximate method by Professor Rathbun is explained in principle in his paper in TRANSACTIONS, Vol. 98 (1933), page 1. The method explained in *The Rigid Frame Bridge* for skewed structures is faulty and will be superseded in future editions; the other methods given there are considered correct and represent the best practice in Westchester County work.

In an attempt to simplify the process of design of

STEEL RIGID FRAME UNDER CONSTRUCTION, FOR CENTRAL BOULEVARD BRIDGE, MOUNT VERNON, N.Y.
Span of 88 Ft from Face to Face of Vertical Legs, Designed by Westchester County Park Commission

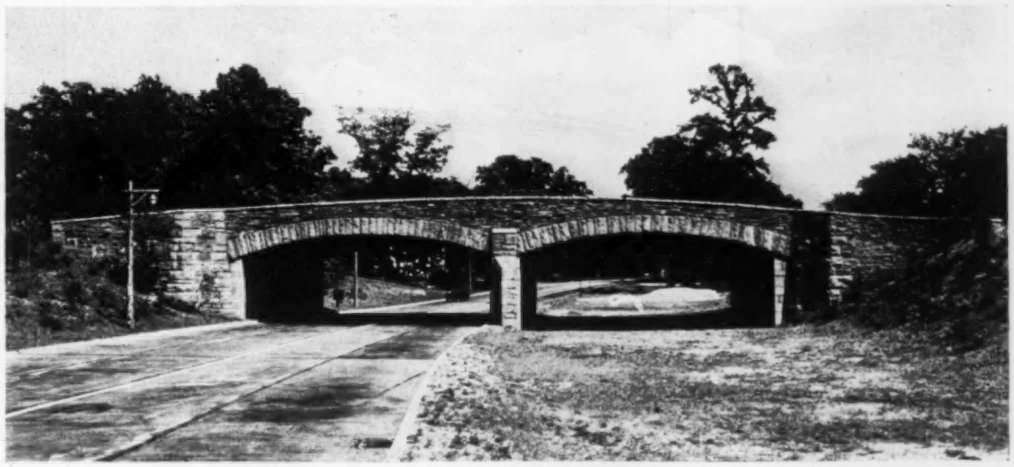
skewed frame bridges, certain relationships have been established, which abbreviate the calculations for the stresses controlling the proportions of the concrete sections and the longitudinal reinforcement. This is part of a study undertaken by the Westchester County Park Commission to simplify the entire process of design. The study was interrupted by a drastic reduction in the engineering forces before relationships were established which would permit an independent calculation of the stresses controlling the proportions of the transverse reinforcement. These stresses are so tied in with the general equations that the designer must follow through with a complete and exact analysis in order to evaluate them, unless he has had sufficient experience in the analysis of skew bridges to be able to judge accurately.

This field of design, therefore, for the present must remain in the hands of the specialist. Approximations may lead to correct results in some cases—in fact, it has been shown that torsional effects are not serious within a certain limited range; but the ordinary non-expert designer cannot always be sure that the conditions of another particular case will not alter the situation. Over-confidence in the general application of empirical rules has led to many structural failures. The policy of using engineers at relief wages to design intricate and important structures, with which they are unfamiliar or inexperienced, is more than questionable; it is positively unethical and dangerous.

SOME ARTISTIC BRIDGES

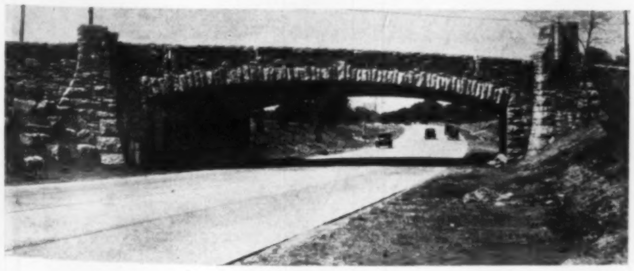
Most of the rigid-frame bridges in Westchester County, which have been widely featured, are stone faced. Some good examples are shown in the accompanying photographs. Stone quarries in the county are abundant, and the stone facing is in keeping with the rugged, rocky nature of the landscape. In other locations the expense of importing stone facing would be prohibitive, and the designer would be compelled to resort to surface finish in concrete.

There are now so many excellent examples that a selection for illustration is difficult. The bridge carrying Six-Mile Road over Middle Rouge Parkway in Wayne County, Michigan, with its clear span of 60 ft, is a fine example of the more formal and conventional type. There is no excess ornamentation to mar the beauty of the structure. The frame bridge in Krape Park, Freeport, Ill., having a clear span of 70 ft, is an excellent example of more modernistic treatment. The bridge carrying the Circumferential Highway over West Street in Dedham, Mass., which has a clear span of 62 ft 3 in. is the first attempt to express the true outline of the rigid-frame structure, and I would like to see more examples of this type. A suggested improvement would be the substitution of iron railings for concrete parapets so as to reduce the top-heavy effect.



Twin-Span Concrete Bridge of Rigid Frame, Stone-Faced

Carries Murray Avenue Over Cross County Parkway, in Westchester County Park System



Typical Rigid-Frame Bridge of Stone-Faced Concrete, as Used in Westchester County, N.Y.

This Span, of 56 Ft Clear Width, Carries Old Mamaroneck Road Over the Hutchinson River Parkway

The Herval Bridge in Brazil, which has been featured many times, is not only a monument to the ingenuity and daring of its engineers in the field of construction, but also is in its simplicity and beauty of outline the finest example of longer-span frame-bridge design. The middle span is 224 ft and the end spans are about 83 ft. This bridge was built over a turbulent river, without the construction of falsework under the main span, by cantilevering the forms for succeeding sections from the completed part, working from both piers toward the center. Taking into account all the difficulties of the situation and the lack of modern facilities for construction in a remote location, the successful construction of this bridge is one of the romances of structural engineering. In addition to the view shown herewith, a construction photograph appeared in the March 1933 issue of Civil Engineering.

There are several good examples of steel rigid-frame bridge construction, but I have no photographs of any but those built in Westchester County. It would be interesting to see one built in which the vertical legs as well as the top of the steel girders are exposed. To support the vertical concrete walls, which retain the roadway approach fill, against the backs of the vertical legs of the girders, would result in economy. The successful treatment of the architectural details of this construction, as it would affect the outside elevations, would require considerable skill.

As all engineers are aware, the rigid-frame bridge is well established as a desirable form of construction from a structural as well as from an artistic point of view. Its field of use for special purposes, such as in grade-crossing elimination where headroom is limited, is widely recognized. It is hoped that the suggestions here made will prove helpful to those engineers faced with this problem and similar ones.

Building Roads in Shenandoah National Park

Area in Virginia Blue Ridge Made Accessible by Recreational Parkway

By H. J. Spelman

Member American Society of Civil Engineers
District Engineer, Bureau of Public Roads, U. S. Department of Agriculture, Washington, D.C.

To promote recreational use of the Shenandoah National Park, an area of 274 sq miles, the federal government is actively engaged in constructing a through highway 95 miles in length, following the main divide of the ridge. This article by Mr. Spelman deals with the construction of the northern two-thirds of the road. The latest parkway standards have been followed as far as practicable by using sweeping curves provided with spiral easements, restricting grades to a maximum of 7 per cent, avoiding heavy cuts and fills, and in general by concentrating on attractive road structures and unmarred landscapes. As trucks will not be permitted on the parkway and little bus traffic is anticipated, a traffic-bound stone base with road-mix bituminous top or surface treatment is being used. When completed, the road will give access to some of the most scenic mountain country in the East.

The Shenandoah National Park consists of a section in the Blue Ridge Mountains of Virginia approximately 90 miles long, extending from the outskirts of Front Royal, Va., on the north to Jarman's Gap, Va., on the south. The land area is of irregular width, ranging from two to eight miles, and contains within its boundaries approximately 175,000 acres. The center of the tract, running northeast and southwest, is roughly the main ridge of the mountains.

For the purpose of opening this newly acquired park for recreational use, a road approximately 95 miles long is now in course of construction. Designed and built in accordance with the latest engineering and architectural standards for recreational routes, it will extend the full length of the park, as shown in Fig. 1. The middle third of the road is now open to traffic; the northern third is under construction; and plans are being completed for the southern third. The work requires heavy and difficult grading, owing to the rugged character of the country and the unusual hardness of the stone encountered. Local materials quarried along the right of way are generally used for surfacing. Considerable care has been taken in location and design as well as in methods of construction to avoid scarring the landscape.

All the area embraced within the park is mountainous in character and ranges in elevation from perhaps 1,000 ft on the lower or valley sides to over 4,000 ft at the highest points. The elevation of the ridge itself varies within the park from 2,165 ft at the lowest gap (Jarman's) to 4,049 ft at the highest peak (Hawksbill Mountain). The park area includes a pleasing variety of rugged mountains, mountain valleys, and some relatively flat mountain meadow land. It is not heavily wooded but plenty of shade is available for those in search of recreation. Because of the high elevation, the park has a delightful summer climate, and because of its nearness to Washington, D.C., Baltimore, Md., and other large cities, it will be much frequented in the summer. Since it has an elevation of over 2,500 ft, the nights are always cool and delightful even in the hottest months.

Shenandoah Park is one of the newer national parks in the eastern area. The Act of Congress authorizing its creation provided that the necessary land should be acquired by the State of Virginia and deeded to the government without cost. Deeds conveying the land to the United States were presented on August 10, 1934, but litigation concerning title has prevented acceptance by the government to date.

At the time the park was authorized it was crossed by only two state roads, both running east and west. One was the principal highway from Washington, D.C., to the Shenandoah valley, known as U. S. Route 211 and as the Lee Highway. It crosses the Blue Ridge through Thornton's Gap at an elevation of 2,300 ft. The other, the Spottswood Trail, crosses the ridge at Swift Run Gap, at an elevation of 2,350 ft. The latter route takes its name from the fact that it crosses the ridge where the colonial Governor Spottswood crossed in one of the first exploratory expeditions into the country west of the mountains.

HIGHWAY PLANNED FOR THE PARK

In order to make the park area accessible to recreation seekers, and particularly that part of it having the finest summer climate, a highway was planned

Roadway After Application of Bituminous Prime Coat
View of Mountains in the Background

Mary's Rock Tunnel Near Southern Entrance
One of the Quarry Sites Is in the Left Foreground

running through from north to south. The north entrance is planned to be near Front Royal, and the south entrance at Jarman's Gap. The elevation of the route at the Front Royal entrance is 690 ft and at the Jarman's Gap entrance, 2,165 ft. The average elevation will be about 2,500 ft, and the highest, 3,679 ft.

The road has been designed as a recreational parkway, having the usual engineering and architectural standards for this type of road. It is considered that the traffic will consist primarily of private cars, and truck traffic other than that necessary for serving the area will not be permitted, although there will be a small amount of motor-bus traffic. The route has been located so as to display the scenic features of the adjacent countryside. Where there are particularly attractive views, outlooks have been established where cars may be parked while their occupants enjoy the scenery. Scars on the landscape due to construction have been avoided as much as possible by proper location. Since the appearance of the road and its effect on the eye of the traveler was considered of great importance, a graceful, curving alignment has been provided.

The alignment is fitted into the hillsides where possible by long easy curves rather than the so-called "broken-back" curves. Stone retaining walls or hand-placed rock embankment was specified to avoid unsightly fills. A minimum radius of curvature of 150 ft and a maximum grade of 7 per cent are used. Grades are compensated for curvature. All curves have spiral easement, and curves of one degree or more are superelevated. The road is fitted to the topography as closely as is consistent with proper precautions for the safety of the type of travel anticipated.

Liberal provision is made for underdrainage although subsoil conditions along the road are generally good. Care is taken in placing fills so that the material will not roll down the mountain sides. On steep slopes ditches are dug to hold the fill. Careful blasting is required to prevent scattering of material. Rocks that are blasted or that roll outside the fill limits must be put back within the fills. Earth slopes in cuts are rounded so that the old and new surfaces blend. In fact, harsh lines are avoided in all parts of the road. Reinforced-concrete box culverts are provided with stone-faced headwalls, and masonry headwalls are used on all pipe culverts.

FACING IMPROVES APPEARANCE OF CONCRETE BOX CULVERT

STONE OBTAINED FROM LOCAL QUARRY SITES

The road is to be surfaced with traffic-bound stone for a width of 20 ft, with shoulders generally 5 ft wide. The stone will be obtained, in part at least, from excavation for the roadway. The thickness of this surfacing will be 6 in. uncompacted. This thickness will be increased as necessary where the subsoil conditions are bad.

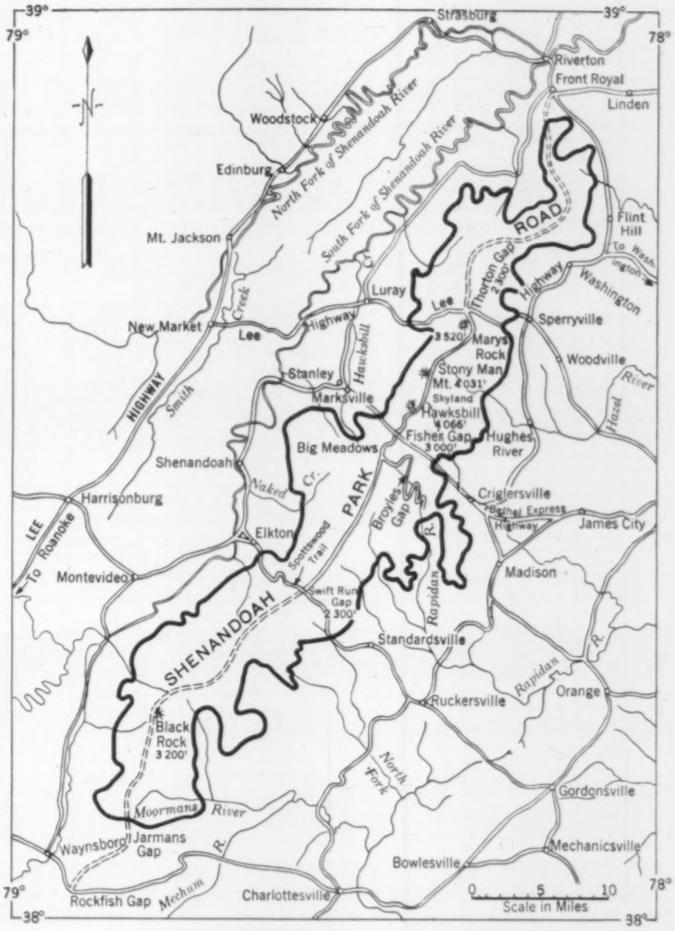

39°
79°
Strasburg
39°
78°
Riverton
Front Royal
Linden
Woodstock
Edinburg
North Fork of Shenandoah River
South Fork of Shenandoah River
ROAD
Flint Hill
To Washington
Washington
Mt. Jackson
Creek
Cr.
Luray
Lee
Thorton Gap 2 300'
Highway
New Market
Lee
Highway
3 520'
Marys Rock
Sperryville
Woodville
HIGHWAY
Smith
Stanley
Hawksbill
Stony Man Mt. 4 031'
Skyland
Hawksbill 4 066'
River
Hazel
Marksville
Big Meadows
Fisher Gap 3 000'
Hughes River
Shenandoah
Naked Cr.
PARK
Harrisonburg
Broyles Gap
Criglersville
Bethel Express Highway
James City
LEE
To Roanoke
Elkton
Spottswood Trail
R.
Montevideo
Swift Run Gap 2 300'
Rapidan
Madison
SHENANDOAH
Standardsville
R.
Rapidan
Orange
Ruckersville
Black Rock 3 200'
North Fork
Gordonsville
Moormans River
Waynsboro
Jarmans Gap
R.
Mechanicsville
Bowlesville
79°
Rockfish Gap
Mechum
Charlottesville
0 5 10
Scale in Miles
78°
38°
38°

FIG. 1. SHENANDOAH NATIONAL PARK

Quarry sites adjacent to the project have been carefully selected in such manner that little or no landscape scar will be visible either to travelers along the parkway or to recreation seekers in the park. The stone surfacing will be crusher-run material, ranging in size from $1^1/_2$ in. down to and including the crusher dust. This material was selected as the cheapest available.

Because of the nature of the traffic, a thick surfacing is not required. Constant blading and dragging during construction produce a very good riding surface. It is planned to place the surfacing in stages. The roadway is to be graded and drained, and the traffic-bound surfacing placed soon after so that the road can be opened at an early date. On the work between Thornton's Gap and Swift Run Gap, a $1^1/_2$-in. road-mix was placed without delay. On the other work the traffic-bound course will be allowed to become thoroughly compacted before it is surface treated or a road-mix course is placed. One tunnel was necessary—at Mary's Rock near the state road crossing at Thornton's Gap.

CONTRACTS LET FOR MIDDLE THIRD OF HIGHWAY

The first two contracts were let in the spring of 1931. These were for grading and drainage only. The one for the section from Thornton's Gap to Big Meadows, approximately 20.6 miles long, was awarded to the Albert Brothers of Salem, Va. The other, for constructing 14.3 miles of the main parkway road from Big Meadows to Swift Run Gap, and also approximately 7 miles of spur road, was awarded to the West Virginia Construction Company of Huntington, W.Va. This spur road, extending from the main road down to the headwaters of the Rapidan, has a narrow roadway, 20 ft over-all. The excavation on these two projects ranged from soil to shale and the hardest trap rock. Eight power shovels were used, all except one being of $1^{1}/_{4}$ or $1^{1}/_{2}$-yd capacity, gasoline driven. Hauling was done by trucks, and leveling by bulldozers and blade graders. The Albert Brothers' contract included the 650-ft tunnel at Mary's Rock, not far south of Thornton's Gap, in which a $1^{1}/_{4}$-cu yd electric shovel was used. These grading contracts were completed in the fall of 1932.

DRY STONE GUARD WALL, IN KEEPING WITH GENERAL CHARACTER OF SURROUNDINGS

In the fall of 1933 contracts were awarded for the construction of a traffic-bound stone base with bituminous road-mix top on these two sections between Thornton's Gap and Swift Run Gap. The northern section, 17.67 miles long, was awarded to the Ralph E. Mills Construction Company of Frankfort, Ky., and the southern section, 16.6 miles long, to the Keeley Construction Company, of Clarksburg, W.Va.

These contracts provided for the use of stone crushed on the job both for the traffic-bound base and for the road-mix surfacing. Crushing operations were begun in December 1933, and were carried forward all winter, except for short shutdowns due to excessive cold. Materials were stored in stock piles. One of the three quarry sites was located at the Mary's Rock tunnel approach in such a way as to produce an improved road alignment, as shown in a photograph. The other two were located where the scars would be effectively screened from travelers along the parkway.

Placing of the stone surfacing was started in the early spring and completed late in August 1934. Because of the unusual hardness of the stone in two of the quarries, only a small amount of fines was produced in the crushing operations—insufficient to bind the material as rapidly as was expected. To expedite compaction, arrangements were made to ship in and apply limestone dust in the amount of about 50 lb per sq yd. Early in September the prime coat of bituminous material was applied, and the road was opened to traffic on September 15, 1934. Construction of the mixed-in-place bituminous top is now under way and will be completed early in August.

During the summer of 1933, some dry-stone guard walls were constructed along the most dangerous embankments on the graded projects. These walls were built by a force of local masons, assisted by unskilled labor supplied by one of the Civil Conservation Corps camps in the area. The work was organized and handled entirely by force account. Stone was quarried along the road at convenient cuts where widening for sight distances on curves was desirable. Similarly, during the summer and fall of 1934, additional guard walls were constructed and a number of parking and outlook areas were built.

CONTRACTS LET FOR NORTHERN THIRD OF ROUTE

During the summer of 1934, three contracts were awarded for the work between Front Royal and Thornton's Gap. These included grading and drainage work and a stone surfacing to be compacted by traffic. The first, for 9.76 miles from Front Royal to Compton's Gap, was awarded to the Waugh Brothers Company of Fayetteville, W.Va., on June 16, 1934. The second, for 10.4 miles from Compton's Gap to Hogback Mountain, was awarded to the Sammons-Robertson Company of Huntington, W.Va., on June 16, 1934. The third, from Hogback Mountain to Thornton's Gap, 10.325 miles, was awarded to the Albert Brothers of Salem, Va., on July 18, 1934. These projects are now under way, with eight power shovels on the work. Hauling is done both by large trucks and by crawler wagons. On two of the contracts the stone for the traffic-bound surfacing is being crushed on the job. On the contract ending at Front Royal, the contractor has elected to use crusher-run material from a nearby commercial plant. These three contracts will be completed early this fall.

The equipment used in the 1931–1933 work was powered exclusively by gasoline engines, but most of that used in 1934 was powered with Diesel-type engines. Drilling is being done largely with well-drilling outfits. The rock excavated on these jobs, like that on the two contracts let in 1931, is largely a very hard trap.

SURVEYS COMPLETED FOR SOUTHERN THIRD OF ROUTE

By June 1935, preliminary surveys were completed for the road from Swift Run Gap to Jarman's Gap at the south entrance to the park. This work will probably be divided into four road contracts and one bridge contract. Each of the road contracts will include grading, drainage structures, and crushed-stone surfacing. The bridge contract is for a structure to carry the parkway over the state road at Swift Run Gap, where the topography makes a crossing at grade impracticable. Plans have been completed for the first road contract extending south for eight miles from Swift Run Gap. It is expected that the plans for the other sections will be completed by October 1, 1935. Studies are also being made to determine the feasibility of a structure to carry the parkway over the state road at Thornton's Gap.

The estimated cost of the 34.3 miles of parkway work already completed and under way between Thornton's Gap and Swift Run Gap—including grading, bituminous road-mix surfacing, parking areas, and stone guard walls—is $1,395,000, or approximately $41,000 per mile. The estimated cost of the work on the 30.8 miles already under contract between Front Royal and Thornton's Gap is $1,342,000, or $44,000 per mile. This includes grading, traffic-bound stone surfacing, and parking areas, but not guard walls or bituminous top. Estimates of the cost of the work between Swift Run Gap and Jarman's Gap are not yet completed. This section is approximately 30 miles long.

This work is being done by the Bureau of Public Roads of the U. S. Department of Agriculture for the National Park Service of the U. S. Department of the Interior, under the terms of an inter-bureau agreement. The resident engineer in direct charge of the work is William M. Austin, highway engineer of the Bureau.

OUR READERS SAY—

In Comment on Papers, Society Affairs, and Related Professional Interests

Methods of Evaluating Storage Questioned

DEAR SIR: The article by Mr. Foster on "Valuation of Upstream Storage Reservoirs," in the May issue, outlines several methods of arriving at how much plants should pay for the benefit of headwater storage. These methods seem to me to be in error. They are here discussed in the order in which they were developed in that article.

In his first case, the value of the storage is determined by the capital cost of an equivalent steam plant, and no allowance is made for the difference in production costs of steam power compared with hydro-electric power.

Also, in estimating the size of this steam plant, the outflow of Project A under the old setup is compared with the inflow of Project A under the new setup, that is, no consideration is given to the storage at Project A in the new setup. Under the old setup the outflow at Project A consists of its inflow plus its storage and totals 1,400 cu ft per sec. Assuming the period of deficient flow as six months, the yield from storage would be 330 cu ft per sec, which deducted from the 1,400 cu ft per sec outflow leaves, 1,070 cu ft per sec as the inflow. Under the new setup, the outflow of Project A would be 2,230 + 70 + 330 = 2,630 cu ft per sec, or a gain of 1,230 cu ft per sec and not the 900 cu ft per sec, and the capital and operating costs of the steam plant would be proportionately increased.

In the second case, which is afterwards declared to give too high a valuation of the storage, the value is determined by using the appraised value of 5.45 mills for firm power, and 2.35 mills for secondary power, and the yield was increased by 50,800,000 kwhr of firm power on a 900 cu ft per sec increase inflow, when actually firm power was increased by 67,700,000 kwhr.

In his analysis of this power, Mr. Foster considers changing all the secondary power into prime power. Actually, this is not possible, unless the storage approaches complete storage. From the data on flow and reservoir capacities, it is evident that the storage at the two plants is not enough to make complete storage, and there will still be two types of power from Project A—firm power, increased by 67,700,000 kwhr by the construction of Project B, and a certain amount of secondary power which cannot be determined from the data given, but which can be assumed as 30,000,000 kwhr.

When Project B goes into operation, Project A is in position to produce 67,700,000 kwhr of prime power, valued at 5.45 mills, but it loses 20,800,000 kwhr of secondary power at 2.35 mills, and its net increase is $320,085 per year. Apportioning this equally as between head and flow, the annual payment from Project A to Project B would be $160,042.50, to be compared with the $78,740, which was stated to "appear to considerably overvalue the storage." If the difference in value between prime power and secondary power is 3.10 mills per kwhr, the differential holds all the way through. Probably Project B feels that it is donating nicely to Project A, when it donates half of $320,085, which is also $160,042.50 per year.

The method in the third case brings up the question as to whether Project A is able to realize on the additional power it can produce by the activities of Project B. In New York State, undeveloped projects pay lower storage rates than do developed sites. This does not seem fair to the developed sites, nor does it seem fair for the undeveloped site to pay at all until it is developed.

The method developed in the fourth case has no relation to the actual value of the storage to Project A When the error in flow and power is disregarded and the $96,068 is accepted as the benefit to Project A, why does the cost of storage appear too high? The cost of 5,800 kw at 3 mills for coal is $152,400 per year in addition to the $59,160 fixed charges.

Any study in which steam and hydro-electric power are to be compared should include consideration of the market. If Project A is operated 8 hr per day or, as a peak load plant, for a less time, the fixed charges of a steam standby for it will mount more rapidly than those of a hydro-electric plant and would, under usual operation, exceed the $96,068, Plant A already having the hydro-electric capacity installed.

In no case has the benefit to other sites, which may or may not exist, been considered. It is possible that such sites would considerably reduce the final cost to Project B, but they could have no effect on the value of the additional storage so far as Project A is concerned.

Zanesville, Ohio E. McD. MOORE, M. Am. Soc. C.E.
June 15, 1935

Surveying Work Should Continue

DEAR SIR: Together with many other members of the engineering profession, some of them engineers of wide repute, I have been very glad to work for the United States Coast and Geodetic Survey during the last two years on a salary scale that, although not munificent by any means, kept the proverbial wolf from the door. Society officers and our immediate superiors, especially R. S. Patton, M. Am. Soc. C.E., Director of the Survey, have done all that they could to secure an extension of the work on the existing basis of pay. They are still busy with their unselfish work, for which we are very grateful.

In spite of all this, it is feared that on August 1 the temporary staff of the U. S. Coast and Geodetic Survey will be disbanded and the only alternative of hundreds of engineers would be to apply for relief. This is regrettable for reasons beyond the personal inconvenience, and even suffering, of the engineers concerned. It is generally conceded that this surveying and mapping work has been economical and intrinsically valuable to the nation. It has succeeded at once in a number of difficult accomplishments such as giving needed work; providing healthy, quickly learned occupations in the sub-professional grade at relatively low rates of pay; securing valuable maps at a most economical cost; and giving opportunities for employing the white collar or professional class who may be in dire need.

For these reasons it seems to be a sound policy and a public benefaction for the Society to continue its interest in this work. In particular the recent action of the Los Angeles Convention in passing a strong resolution urging continued financial support of mapping by the government and addressed "to the proper federal authorities" should prove most helpful.

The benefits in view are worthy of these and all other efforts to continue this valuable work.

P. INFANTE, M. Am. Soc. C.E.

Brooklyn, N.Y.
July 16, 1935

Closure of Discussion

TO THE EDITOR: In closing discussion on my article on "Neutral Axis in a Reinforced Concrete Member Subjected to Combined Stress," in the October 1934 issue, I should like to comment on Mr. Nelidov's letter on page 181 of the March 1935 issue of CIVIL ENGINEERING. Mr. Nelidov informs me that his reference to page 40 is a misprint and should have been to page 46. Furthermore, the reference occurs in Part I of the book referred to (there are three parts, each paged separately).

More important than the misprint, however, is Mr. Nelidov's statement that the method I presented "was similar to that described on page 40" (should be 46) of Johnson, Bryan, and Turneaure, Part I, "which is given in reference to plain concrete section only." What is given in Johnson, Bryan, and Turneaure is Mohr's and Culmann's graphical methods, respectively, for determining moments of inertia. Culmann's method involves the use of two string polygons, and there the similarity with the method I presented stops. There is no mention of plain concrete, nor any hint of an extension of Culmann's method to the determination of the neutral axis in any kind of material. The neutral axis is not even mentioned. Guidi's method of determining the neutral axis in a reinforced-concrete member bears exactly the same relation to Mohr's method of determining moments of inertia as the method I presented bears to Culmann's method. No one, so far as I know, has ever suggested that Guidi's method was covered by Mohr.

For these reasons Mr. Nelidov's statement seems to me misleading.

WILLIAM R. OSGOOD, Assoc. M. Am. Soc. C.E.
Materials Testing Engineer

Washington, D.C.
July 6, 1935

Item on Engineering Fallacies Discussed

DEAR SIR: In an article entitled "Engineering Fallacies More or Less Common" by Robins Fleming, which appeared in "Items of Interest" in the May issue of CIVIL ENGINEERING, a very common mathematical fallacy that occurs only too frequently in engineering textbooks has, unfortunately, been repeated in his statement that

$$y = \int\int \frac{d^2y}{dx^2}\,dxdx = \int \frac{Mxdx}{EI}$$

The expressions in the above equation are not equal to each other, and the integration by which Mr. Fleming derived the last expression was not correctly performed. The valid equation is

$$y = \int_0^x \left[\int_0^x \frac{d}{dx}\left(\frac{dy}{dx}\right) dx \right] dx$$

This is an integral of an integral in which the quantity within the parenthesis must first be integrated.

In order to clear up this very common error, the following general analysis is presented in Fig. 1, in which the beam ACB has been deflected by any system of loads to the position $AC'B$;

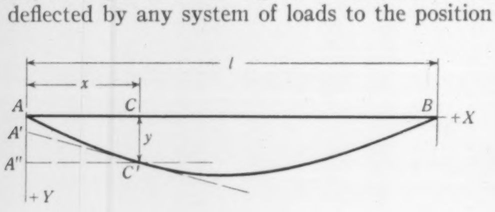


FIG. 1

A and B are assumed to be fixed in space; and C has deflected an amount y to C'. The point C' is located by Cartesian coordinates x and y, with origin at A.

The well-known, accepted, fundamental differential equation of the deflected beam is

$$\frac{d^2y}{dx^2} = \frac{d}{dx}\left(\frac{dy}{dx}\right) = \frac{M}{EI}$$

Multiplying both sides of this equation by xdx, we get

$$xd\left(\frac{dy}{dx}\right) = \frac{Mxdx}{EI}$$

Integrating both sides between the limits A and C, using the method of parts for the first expression, we get

$$\left[x\left(\frac{dy}{dx}\right) - y\right]_0^x = \int_0^x \frac{Mxdx}{EI}$$

or

$$xi_x - oi_o - y + y_o = \int_0^x \frac{Mxdx}{EI}$$

For the system of coordinates selected, $y_0 = 0$; i_x = slope at x; and i_0 = slope at the origin. Therefore,

$$y = -\int_0^x \frac{Mxdx}{EI} + xi_x + y_o$$

In this equation M is negative for simple beam bending, i_x is the slope of the curve at x, y, and y_o is the deflection at the origin where $x = 0$. This deflection is zero for an unyielding support at A.

Referring to Fig. 1,

$$y = CC' = AA' + A'A'' = -\int_0^x \frac{Mxdx}{EI} + xi_x$$

Only when $i_x = 0$, a very special case, namely, at the center of a symmetrically loaded simple beam, is the deflection equal to

$$y = -\int_0^{\frac{l}{2}} \frac{Mxdx}{EI}$$

In general,

$$\Delta = \int_0^x \frac{Mxdx}{EI}$$

where Δ is not y but the deflection of the beam at the origin of coordinates measured with reference to the tangent at x, the so-called slope-deflection relation.

ALBIN H. BEYER, M. Am. Soc. C.E.
Professor of Civil Engineering
Columbia University

New York, N.Y.
June 24, 1935

Automobile Driver Responsible for Speed

DEAR SIR: The clarity of Mr. Wheeler's article, "Coordinating Automobile and Highway Design," in the July issue of CIVIL ENGINEERING, is most refreshing to me, the family chauffeur. However, I cannot agree that the problem is in any way partly the responsibility of the automotive engineer. In my opinion, any attempt to limit the ingenuity of the designer of, and the development of, better and faster automobiles to meet the limitations of highways would be a very short-sighted procedure. An automobile designed for any speed can always be driven at any lower safe speed. Therefore, to me the problem is between the highway engineer and the driver of the automobile.

Highway engineers themselves are often to be criticized, perhaps because of circumstances not their fault. How many highways are there with mile after mile of perfectly banked curves, on which one may safely drive 60 miles an hour or over, only to come suddenly to a curve that is not banked at all and is without a warning sign?

Has anyone ever been on a highway where the maximum safe speed was posted along the highway? I have not, and yet this would be a very simple solution of the whole problem. Today the maximum safe speed is determined only by the judgment of the driver, if he has any. If, for economic or other reasons, it is not feasible to build a highway for a safe speed over 25 or 30 miles an hour, let that speed be posted conspicuously, and let the police or the undertaker get the man who drives faster over it. By the same reasoning, if a 150-mile highway can be built, why not build it and post it and let the development of the automobile be unreserved? No sane driver would object if a highway were designed for varying speeds at different locations, as long as the maximum safe speeds were clearly posted along the route.

To me, Mr. Wheeler's argument that, because automobiles are being designed for speeds of 100 miles an hour or over, all highways are obsolete if they cannot be driven on safely at this speed, is untenable. The 15-mile highway of yesterday is still useful, and the modern car can be driven perfectly over it. The 100-mile highway of today will still be useful even when automotive genius presents us with automobiles capable of a safe speed of 200 miles per hour.

R. P. PENNOYER, Assoc. M. Am. Soc. C.E.

Pittsburgh, Pa.
July 9, 1935

Simple Solution of Cubic Equations

To the Editor: The method of solving cubic equations, as presented by Mr. Whiteman in the October 1934 issue, is both practical and interesting. However, this method is specialized, since it requires the use of a specially constructed slide rule. The following method is general and applies to transcendental as well as algebraic equations. Briefly stated, it is as follows: if a real root of the equation, $f(z) = 0$, lies between z_1 and z_2, its value can be found to any desired degree of accuracy. For instance, if a is a first approximation to the correct value

$$a - \frac{f(a)}{f'(a)} = b \text{ is a second closer approximation, and}$$

$$b - \frac{f(b)}{f'(b)} = c \text{ is a third still closer approximation.}$$

This process can be continued indefinitely to any desired degree of accuracy, and f and f' have their usual mathematical significance, denoting function in question and its first derivative, respectively.

There are two methods of finding a first approximation to a root. For brevity, they can be called the mathematical, or scientific, method and the engineering, or trial, method. In the application of the former, a clear understanding of the general theory of equations is necessary, and if such is the case a first approximation can easily and quickly be found. In the second, or engineering, method integral values of the variable are substituted in the equation until two values are found such that the root lies between them. Thus if 1 and 2 are substituted for z in the transformed cubic equation, $z^3 - 3z - 1 = 0$, it is clearly seen that a root must lie between these two values. Arbitrarily choosing 1.5 as a first approximate value for the root in question and applying the foregoing formulas, 2.06 is a second approximation, 1.9 a third, and 1.881 a fourth.

But this procedure can be improved upon. It is generally best to locate the first approximate value of the root within a range such that when ±0.05 is added to this first approximation, the resulting value will be greater or less than the root in question. The utility of this latter step is self-evident in the numerical solution of a problem.

Table I illustrates completely the solution of the equation $f(z) = z^3 - 3z - 1 = 0$, from which $f'(z) = 3z^2 - 3$, using the modification previously explained.

Table I. Solution of Equation, $f(z) = z^3 - 3z - 1 = 0$

Row	Values of z	$f(z)$	$f'(z)$	$\frac{f(z)}{f'(z)}$	$z - \frac{f(z)}{f'(z)}$
1.	1	−3			
2.	2	1			
3.	1.2	−2.87			
4.	1.8	−0.57			
5.	1.9	0.85			
6.	1.85	−0.21	7.3	−0.0288	1.8788
7.	1.879	−0.0029	7.59192	−0.00038	1.87938

Rows 1 and 2 locate a root between $z = 1$ and $z = 2$, and Rows 3, 4, and 5 further locate this root as lying between $z = 1.8$ and $z = 1.9$. Arbitrarily assume 1.85 as a first approximate value of this root (1.85 ± 0.05 = 1.9 or 1.8). This gives 1.8788 as a second approximation which, for all practical purposes, is close enough. If a more accurate value is desired, take 1.879 as the second approximation, giving 1.87938 as a third approximation. When this latter value is substituted in the original equation, it is shown to be in error by −0.00004. Row 6 was calculated by means of the use of logarithms, but all the other calculations in the table and elsewhere were performed on an ordinary 10-in. slide rule. Other real roots of the equation can be found in a similar manner or by dividing the original equation by z, the root found, and operating on the resulting equation as desired.

The advantage of the foregoing method is that it is general and can be applied to any algebraic or transcendental equation, regardless of degree. Likewise, it is quite unnecessary to transform the original cubic equation into one lacking the term in x^2. The original can be solved just as easily by the foregoing method. This method is short and requires practically no memorizing. It is based on a theory first set forth by Sir Isaac Newton and can be found in any good text on the theory of equations.

Francis L. Castleman, Jr., Assoc. M. Am. Soc. C.E.

Philadelphia, Pa.
June 20, 1935

Comments on Cape Cod Canal

To the Editor: The article by Lieutenant Harwood on "Proposed Improvement of the Cape Cod Canal," in the March issue, recalls interesting aspects of the construction of this project, the general design of which was completed in 1905 by my partners, the late William Barclay Parsons, Hon. M. Am. Soc. C.E., and Eugene Klapp. The only important difficulty involved in building the canal resulted from the fairly large number of big boulders that were encountered in the excavation, especially where the work was done by suction dredges and small equipment. The two large dredges, which were equipped with 8 and 10-yd dippers, naturally handled the boulders with less difficulty and expense.

Regardless of borings, I am firmly convinced that many large boulders will be encountered in any excavation of appreciable depth in the Cape Cod area. The canal was built in a terminal moraine that extends from west of Buzzards Bay to Provincetown, and there are hundreds of large-sized boulders in the region. In any case, when a boulder is encountered in boring I assume that it is one of a nest, especially in the Cape Cod region where the boulders are generally found in clusters.

Originally the six miles through the land section of the canal had a bottom width of only 100 ft. With a 3-knot current, this was obviously too narrow for the safe navigation of large ships or square-nosed coal barges. In spite of its narrow width, however, the canal really did an excellent business and received a very high toll per ton mile, amounting to approximately 14 cents in 1924. In most other ship canals the toll per ton mile varies between about 5 and 8 cents, if there is one at all. Several boats were sunk in the canal during the early days of operation but this did not materially decrease the traffic. And I am convinced that when the canal has been widened to its ultimate width of 500 ft, or even 300 ft, the traffic through it will be very great. In fact, it has been demonstrated that such improvement is much needed. For two or three years following the construction of the canal, there was a good deal of erosion of the banks, which had been slightly riprapped, and there was also considerable erosion of the bottom. As the fine sand was removed by erosion and the bottom and sides became paved with the coarser gravel and cobbles, the erosion, of course, decreased. The worst place of lodgment was near the Sagamore Bridge. This was due to the fact that the width of the bridge was 160 ft, and that the bottom width of the western approach to the canal was 100 ft and that of the eastern approach, 200 ft. As a result, there was an offset at this point that made a catchment.

The Buzzards Bay Bridge, the main span of which is 550 ft long, is perhaps the longest lift span in the world. Since it was designed to remain open normally, we assumed higher wind pressures than are commonly used. Also, on account of the size of the bridge and its great weight—8,600,000 lb—roller bearings, instead of the ordinary type, will be used to reduce the power requirements.

At one time it was suggested that aluminum be substituted for steel, because the additional cost would be negligible. Although this was a worthy suggestion, the short time available for designing the bridge did not enable us to make the necessary studies of, and experiments with, this type.

In the construction of the Buzzards Bay Bridge, architects were for the first time associated with engineers in the effort to produce a lift bridge that would be pleasing to the eye. The lift bridge does not lend itself readily to the creation of a beautiful structure, because its lines are complicated by the appearance of counterweights, machinery, and cables. The architects who collaborated with us in the design of the structure are the firm of McKim, Mead, and White, of New York. Our associate, J. A. L. Waddell, M. Am. Soc. C.E., who in 1892 designed the first vertical lift in this country, and his partner, Shortridge Hardesty, M. Am. Soc. C.E., also assisted with the design.

Walter J. Douglas, M. Am. Soc. C.E.
Consulting Engineer

New York, N.Y.
June 24, 1935

Study of Climatic Cycles of Interest to Hydraulic Engineers

TO THE EDITOR: The article by Frank E. Bonner, M. Am. Soc. C.E., on "Climatic Cycles in the West," in the June issue, is of interest to all hydraulic engineers. Every hydraulic project involves an estimate of future water supply. Hitherto, such estimates were merely based on the average of past records, the average for the future being considered as equal to the average of the past. Unfortunately, however, experience shows that such a procedure occasionally leads to financial failure. If a project, say of a hydroelectric station, which is just able to pay revenue on capital invested on the basis of past records, after completion experiences a succession of drought years, it will yield insufficient returns and financial failure may result. Run-off moves from higher to lower averages and vice-versa; and recent studies, conducted by the U. S. Geological Survey, plainly show that past averages may be a poor key to the expectation of the immediate future.

In 1917 an experience involving a $5,000,000 investment induced me to investigate the subject more closely. The question to be answered is: Are run-off quantities fortuitous in succession, or do they contain systematic sequences? Also, are the systematic sequences important enough to be used for future estimates? Literature on the subject of climatic cyles is very voluminous, and the question cannot be disposed of by merely comparing records as Mr. Bonner proposes. The records must be subjected to a suitable analysis, which will show at once whether hidden correlations exist, and whether these are large enough to be of practical importance. I should like to refer here to two studies—"On the Investigation of Cycles and the Relation of the Brüchner and Solar Cycle" in the July 1926 *Monthly Weather Review*, and "The Practical Importance of Climatic Cycles in Engineering" in the October 1929 issue of the same periodical—to illustrate my point. Mr. Bonner's Fig. 1 may be compared with Fig. 4 on page 294 of the July 1926 issue of the *Monthly Weather Review*, and his Fig. 3 may be compared with Fig. 5 on the same page of that issue. These comparisons will show that proper analysis makes the relations plainly visible.

I brought out the fact that, for certain regions, such relations can be important enough to be of practical application in an article on "Systematic Sequences in Annual Stream Flow," in the November 1932 issue of CIVIL ENGINEERING. This shows that the droughts of 1930 and 1931 could, for the Great Lakes region, be established in 1928. The accuracy of these estimates, which were published at least a year in advance of the droughts, may be verified at any time. The result of my eighteen years of investigations may be summarized as follows:

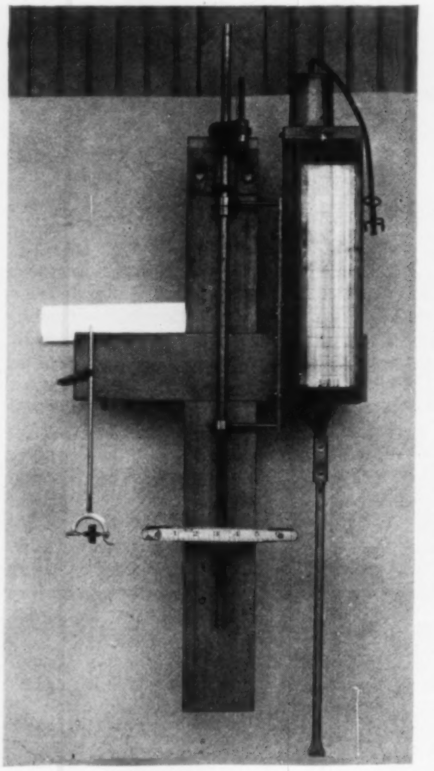
1. In continental plains, such as the Great Lakes region and the great Russian plains, systematic sequences are very pronounced. Mountain chains, such as the Rocky Mountains and the Alps, and coastal regions show a predominance of fortuitous sequences.
2. In the Great Lakes region it becomes possible to estimate average annual run-off, one year in advance, quantitatively within 5 per cent.
3. The predominant cycle in run-off is the so-called Horton cycle, found by R. E. Horton, M. Am. Soc. C.E., and published in the U. S. Geological Survey water-supply paper No. 30. It now appears that this cycle is also present in the solar constant as measured by the Smithsonian Institution. Four periods of the Horton cycle are equal in length to the magnetic cycle of the sun.

A. STREIFF, M. Am. Soc. C.E.
Vice-President, Ambursen Dam Company

San Antonio, Tex.
July 5, 1935

Velocity Tube in Use in Iowa Laboratory

TO THE EDITOR: The article on "The Bentzel Velocity Tube" by Lieutenant Falkner, in the April issue, is very interesting. Several months ago an instrument corresponding in a general way to those in use at the U. S. Waterways Experiment Station in Vicksburg was constructed by C. H. Smoke, a member of the staff of the U. S. Engineer Department at the Iowa Institute of Hydraulic Research in Iowa City. I calibrated this instrument and used it to obtain velocity measurements in river models.


INSTRUMENT FOR OBTAINING VELOCITY MEASUREMENTS IN RIVER MODELS

In this instrument, which is illustrated in the accompanying photograph, $^3/_{16}$-in. brass tubing was used for the circuit except for the tapered glass tube and pyrolin air trap at the top. Graduations were marked on a sheet of pyrolin placed in front of the tapered tube, and two mirrors mounted at an angle in the back were employed to prevent parallax. A hook-gage staff was used for setting the orifices at the correct depth in the model, and the large wooden cross had a runner attached to the back, so that the velocity tube could be mounted on a model work bridge and set at any position desired from the standpoint of operation.

The float of this velocity tube, made from hard rubber, was turned on a lathe, a cavity being left in the center, which was loaded with brass filings, to give the required buoyancy, and then sealed with a rubber compound. The characteristics of the float were such that practically no correction of readings was necessary to allow for changes in temperature of the water within the range for which the instrument was calibrated, 50 to 80 F. Some difficulty was experienced in taking readings because of air bubbles that collected on the float. This was overcome by allowing the water to drain out of the instrument frequently, thus removing the bubbles. The water in the circulating system at the laboratory is usually at about the same temperature as the surrounding air, and the long surface exposure in the river models allows most of the entrained air to escape.

The velocity tube was calibrated first in a rotating flume, and later by comparison with a miniature current meter that had previously been calibrated in a straight flume. The two calibrations checked within about 7 per cent. The photograph previously referred to shows the miniature current meter used in the calibrations. This is one of several meters constructed by Mr. Smoke in 1931. The current meter and the velocity tube may be interchanged in the mounting shown. The velocity tube registers velocities as low as 0.30 ft per sec, whereas the miniature current meter reads as low as 0.10 ft per sec.

In the Iowa Institute of Hydraulic Research the velocity tube is used only where it is impossible to use the miniature current meter, since the current meter is considered a simpler and more reliable method of determining model velocities. However, with further improvement of the Bentzel instrument, it is believed that an important service will have been rendered to hydraulic model investigators.

CHARLES B. SPENCER, Jun. Am. Soc. C.E.
U. S. Engineer Department
Iowa Institute of Hydraulic Research

Iowa City, Iowa
June 28, 1935

SOCIETY AFFAIRS

Official and Semi-Official

Highlights of Annual Convention at Los Angeles

Southern California Engineers Act as Hosts to Society, July 3 to 7, 1935

OUT IN THE land of the setting sun a thousand members of the Society and their guests gathered for the Sixty-Fifth Annual Convention held in Los Angeles, July 3 to 7, 1935. Civil engineers trekked from the four corners of the United States by train, airplane, automobile, and boat to learn of the latest developments in water conservation, irrigation, soil erosion, traffic control, power generation, state planning, aqueduct, tunnel and dam construction, water and sewage purification, and harbor development. Not only were these problems discussed but their significance in the development of the West was considered.

BREAKFAST CLUB ENTERTAINS

The Convention festivities began early on Wednesday, July 3, when a group of 250 were guests at the Breakfast Club of Los Angeles. The "breakfast room" at the Ambassador Hotel was filled to overflowing with a thousand early risers who sought good fellowship and inspiration while consuming quantities of ham, eggs, and coffee together and being entertained by internationally known artists and renowned personalities. Not only was President Tuttle called upon for a short address concerning the profession and the Society, but Mme. Schumann-Heink, Mme. Galli-Curci, and the La Scala Choir entertained with vocal music. All were enthusiastically received.

Actually the Convention was opened at 10:00 o'clock, when Alfred Jones, Assoc. M. Am. Soc. C.E., president of the Los Angeles Section, called the meeting to order and introduced His Honor, Frank L. Shaw, mayor of Los Angeles. The Mayor, metaphorically speaking, opened wide the gates of the city to the Convention and handed the keys to President Tuttle. Following a fitting response on behalf of the Society, the President delivered his prepared annual address, "The Development of the American Society of Civil Engineers." This address is to appear in the 1935 TRANSACTIONS where it may well be read by every member of the Society.

Replete with human interest is the story of the ranchos of southern California. Palmer Conner, a student of the history and romance of these ranchos, gave a vivid picture of the days of the Spanish dons and padres, in and about Los Angeles. He also described the early survey of Los Angeles, made by Lieut. E. O. C. Ord of the Corps of Engineers, U. S. Army, and the transfer of titles of ranchos for settlement of attorney's fees and grocery bills and even the giving of a consideration with the land for the acceptance of the land itself.

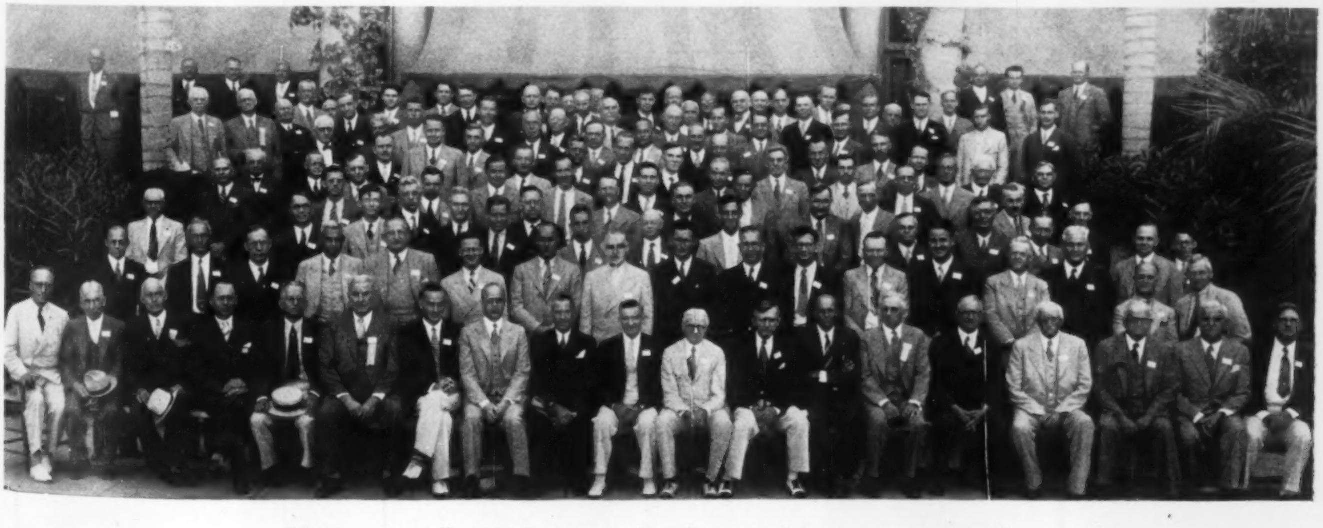
After individual and group luncheons in one of the several hotel dining rooms, coffee shops, terraces, and tea parlors, a general meeting was called to order for an intimate discussion of three papers on the engineering aspects of the metropolitan area of Los Angeles. These papers discussed the physiography of the region, the engineer's contribution to its development, and the engineering outlook for southern California.

TECHNICAL DIVISIONS HOLD INTERESTING MEETINGS

Thursday was given over entirely to the sessions of the Technical Divisions of the Society. In these sessions the specific problems of the specialist in the fields of power development, city planning, irrigation, construction, sanitary engineering, and waterways were considered. These subjects were presented and discussed in a more technical style than were those on Wednesday. In spite of the fact that the day was a national holiday, July 4, the attendance at the various sessions was remarkably good, and members often found it necessary to attend parts of concurrent sessions in order to cover the field of their professional interest.

The Society's Committee on Regional Meetings, consisting of Henry D. Dewell, Vice-President of the Society, and Ivan C. Crawford, B. A. Etcheverry, Theodore A. Leisen, and Ralph J. Reed, Directors, cooperated with an aggressive local committee headed by W. W. Hurlbut and A. M. Rawn, Members Am. Soc. C.E. The excellence of the technical program and the pleasure of the visiting engineers and guests were due to the fine spirit of cooperation and cordiality displayed by these two committees. No effort seemed too great and no detail too small to be taken up and followed through to a satisfactory conclusion. The thanks of the Society are due the members of the various committees, which functioned to make the Los Angeles Convention one long to be remembered.

En route to the Convention, a special car of delegates from New York picked up others in Chicago, and the two groups enjoyed a specially arranged tour to Salt Lake City, national parks, and other points in Utah; the northern rim of the Grand Canyon of the Colorado; and Boulder Dam. An account of this tour appears elsewhere in this issue.



MEMBERS AND GUESTS ATTENDING LOS ANGELES CONVENTION ON JULY 3

On Wednesday night the dinner dance in the Fiesta Room of the Ambassador proved unusually attractive. Food, music, and entertainment were perfect, and the dancers would not leave until the lights were dimmed.

Parties were made up for special trips. For instance, 40 went up Mt. Wilson to see the 100-in. telescope. Others visited the Hunington Library in San Marino; the Carnegie Seismological Laboratory in Pasadena; the Art Gallery; the construction of the Colorado River Aqueduct of the Metropolitan Water District; and the sewage treatment plants of the Los Angeles County Sanitation Districts and of the city of Pasadena. Also, special arrangements were made to facilitate inspection of several local manufacturing plants.

LADIES ROYALLY ENTERTAINED

Nor were the ladies omitted from the plans of the local committee on entertainment. Mrs. Robert Linton headed a group of 38 wives of members of the Los Angeles Section who left no stone unturned in their effort to make the stay of the visiting ladies in Los Angeles as interesting and pleasant as possible. On Wednesday, soon after the Breakfast Club party broke up, the ladies were taken for a drive in comfortable automobiles to Claremont, going by way of Pasadena, past the San Gabriel Mission, and through the citrus groves. At the Mission, an adobe house, which was built in 1709 and which until 1903 was the home of the Franciscan Fathers connected with the Mission, still stands on the grounds and is today a museum of relics of early California days. It proved an interesting stopping place en route to Claremont. At the Padua Hills dining room, at Claremont, the party was entertained during luncheon by a group of Mexican players. On Thursday they were taken by bus to the home and gardens of Mr. and Mrs. Harvey Mudd in Beverly Hills for tea, and to the estate of Capt. and Mrs. John D. Fredericks in Bel-Air for a reception and garden supper party. Later in the evening, they attended a performance at Sid Grauman's Chinese Theater in Hollywood.

GROUP INSPECTING PARAMOUNT STUDIOS, JULY 5

Not to be outdone by their engineer escorts, the ladies joined them on Friday morning for an inspection trip to the studios in Hollywood, where talking pictures are made and where "Mickey Mouse" reels originated and are now produced. The party was divided into ten groups, and four studios were opened for their inspection.

On Saturday a visit to the resort community of Avalon on Santa Catalina Island, 25 miles out in the sea from Los Angeles Harbor, proved an attraction. To many the view of the unusual marine gardens, obtained through the glass bottoms of specially built boats, was a never-to-be-forgotten experience.

Sunday was set aside for San Diego and the California Pacific International Exposition. In honor of the members attending the Annual Convention, the day was designated American Society of Civil Engineers' Day at the exposition. Headed by Fred D. Pyle, M. Am. Soc. C.E., president of the San Diego Section, a delegation of San Diego members greeted the party, guided them through the fair, and showed them the city. It is rumored that some of the visitors were enticed over the international boundary into Lower California by promises of pots of gold to be found at the end of a rainbow in Agua Caliente. No reliable record is available of who conducted this search or of what was found in Old Mexico.

SOME RECORDS OF ATTENDANCE

Records of the approximate attendance at the various technical sessions and social events disclose the following figures:

Total estimated attendance	1,000
Wednesday morning:	
Breakfast Club	230
Opening session	230
Afternoon session	210
Ladies' trip to Padua Hills	130
Wednesday evening:	
Dinner dance and entertainment	280
Thursday morning:	
Highway Division	35
Power Division	50
City Planning Division	45
Irrigation Division	125
Thursday afternoon:	
Irrigation Division	110
Construction Division	205
Sanitary Engineering Division	45
Waterways Division	50
Thursday:	
Drive, supper, and evening theater for ladies	120
Golf tournament and smoker, Wilshire Country Club	210
Friday:	
Tour to "talkie" studios	310
Saturday:	
Trip to Catalina Island	30
Sunday:	
San Diego Exposition—American Society of Civil Engineers' Day	75

Thus ended a week of work, of profit, and of pleasure. The work began on Sunday and continued on Monday and Tuesday when sessions of the Board of Direction and its committee, some of which lasted into the small hours of the morning, were held. The profit resulted from the technical programs, and the pleasure was a by-product of renewing old acquaintances and making new friends. Those who found it necessary to forego the pleasure of attending the Convention will do well to study the abstracts of all the technical papers as they will be presented in the September issue of CIVIL ENGINEERING.

LADIES ATTENDING SUMMER CONVENTION POSE FOR PICTURE

Constitutional Amendments

Two amendments of the Constitution are now in process for adoption or rejection by the Corporate Membership of the Society. Both were proposed by the Board of Direction.

Amendment procedure is as follows: Proposed amendments were submitted in writing and signed by not less than thirty Corporate Members. These two amendments, having been received more than sixty days previous to the date of the Annual Convention, were sent to the Corporate Members, by letter, twenty-six days prior to the Annual Convention. They were in order for discussion at the business meeting during the Annual Convention held at Los Angeles on July 3, 1935. One of them was slightly amended at that meeting, upon recommendation of the Board of Direction. In form originally proposed, or as amended, they are to be voted on by letter ballot, the vote to be counted at the first regular meeting in October. The Board of Direction has voted "that a call be issued for a regular business meeting of the Society to be held in New York on October 16, 1935, for the purpose solely of canvassing the ballots on the present proposed Constitutional amendments." An affirmative vote of two-thirds of all ballots cast is necessary to the adoption of any amendment.

Proposal No. 1, providing for changes in the Society's membership grades, was amended, upon recommendation of the Board of Direction, by the Corporate Members assembled in the business meeting at the time of the Annual Convention by a vote to substitute the word "five" for the word "ten" as it first appears in the second sentence of the original amendment to Article II, Section 2, and to substitute the word "five" for the word "ten" in the first sentence of Article II, Section 11. With this change, amendment proposals No. 1 and No. 2 will go to ballot.

Did You Know That . . .

Initiating its policy of defending members unjustly accused, the Society has secured vindication of two Kansas engineers . . . . p. 492

A five- instead of ten-year period of Society membership is stipulated for eligibility to the proposed grade of Fellow . . . . p. 491

The net assets of the Society, now estimated at almost one-and-a-half million dollars, are greater than at any time in its history. See President Tuttle's address . . . . p. 496

Modification of new work-relief regulations to permit construction of more useful public works has been recommended by the Los Angeles Convention . . . . p. 492

Conferences of representatives from Local Sections are to be reinstituted, beginning with the Fall Meeting at Birmingham . . . . p. 504

The first sentence in Amendment Proposal No. 1 of Article II, Section 1, is to read as follows: "On November 15, 1935, all Members who have held that grade for five years and who have had twenty-five years of active practice, shall be termed Fellows. . . ." The second sentence of Section 11 provides for the transfer of present Associate Members or present Members not automatically termed Fellows in the interval between November 15, 1935, and November 15, 1937, to the grade of Fellow, provided they have the qualifications of that grade.

In anticipation of the need for interpretation of the words "who have had twenty-five years of active practice," the Board of Direction at its meeting held on July 1 and 2, 1935, at Los Angeles voted as follows:

"That, contingent upon the adoption of the present proposed amendment of Article II and Article IV of the Constitution of the Society, the number of years of membership in the Society in any grade, plus the requirements relating to active practice which prevailed at the time of admission shall be considered prima facie evidence of the minimum years of active practice with relation to all Members who, on November 15, 1935, are otherwise eligible for automatic designation as "Fellows" and to all Corporate Members who between November 15, 1935, and November 15, 1937, shall apply for transfer to the grade of Fellow."

The proposed amendments read as follows:

Proposal No. 1

"*Amend Article II—Membership*

"Amend Section 1 by changing the second and third sentences to read:

"'The Corporate Members shall be designated as Fellows and Members. There may also be connected with the Society, Honorary Members, Affiliates, Junior Members, and Student Members, who shall be entitled to all the privileges of the Society, except the right to vote and to hold office therein; provided that Honorary Members elected from the Corporate Members of the Society shall retain their right to vote and to hold office.'

"The Section as amended will then read:

"'1. A Corporate Member of this Society shall be a Civil, Military, Naval, Mining, Mechanical, Electrical, or other professional engineer, an Architect, or a Marine Architect. The Corporate Members shall be designated as Fellows and Members. There may also be connected with the Society, Honorary Members, Affiliates, Junior Members, and Student Members, who shall be entitled to all the privileges of the Society, except the right to vote and to hold office therein; provided that Honorary Members elected from the Corporate Members of the Society shall retain their right to vote and to hold office.'

"Strike out Sections 2 and 3 and substitute the following:

"'2. After November 15, 1935, Fellowship in the Society shall be confined to persons who have become notable in the practice of engineering. After November 15, 1935, a Fellow, at the time of his admission to that grade, shall have been a Member of the Society for not less than five years and shall have been engaged in the active practice of his profession for not less than twenty-five years and for at least ten years thereof shall have been responsibly engaged in work of substantial importance requiring engineering ability of a high order. The Board of Direction, by not less than an 80% vote of the entire Board, may waive the requirements as to membership and length of experience, and elect an engineer to the grade of Fellow on the basis of exceptionally distinguished achievement.'

"'3. A Member, at the time of his admission, shall have had responsible charge of work as principal or assistant for at least one year, and shall have been in the active practice of his profession for at least eight years, and shall be not less than twenty-seven years of age.'

"Renumber Section 6 as Section 5.

"Renumber Section 5 as Section 6, and amend by inserting the word 'Fellow' before the word 'Member,' and changing the term 'Associate Member' to the term 'Affiliate,' making the Section read:

"'6. Any person having the necessary qualifications prescribed in this Article to entitle him to admission to the grade of Fellow, Member, or Affiliate, shall be eligible for such membership, though he may not be practicing his profession at the time of making his application.'"

"Amend Section 7, paragraph 1, by changing the term 'Junior' to 'Junior Member' in the first sentence, and striking out the word 'Associate' before the word 'Member' in the second sentence, making the Section read:

"'7. A Junior Member, at the time of his admission, shall have had active practice in some branch of engineering for at least four years, or he shall have been graduated in engineering from a school of recognized standing. He shall be not less than twenty years of age, and his connection with the Society shall cease when he becomes thirty-three years of age unless he be previously transferred to the grade of Member.

"'Persons who were in the Junior grade prior to March 4, 1891, shall not have their status changed by the provisions of this Section.'

"Strike out old Section 9, renumber Section 8 as Section 9, and insert new Section 8, to read:

"'8. A Student Member shall be a regularly enrolled Junior, Senior, or graduate student in an engineering school of recognized standing. His connection with the Society shall cease when he ceases to be an enrolled student.'

"Renumber Section 11 as Section 12 and add new Section 11, to read:

"'11. On November 15, 1935, all Members who have held that grade for five years and who have had twenty-five years of active practice, shall be termed Fellows; Associate Members shall be termed Members; and Juniors shall be termed Junior Members. For a period of two years following November 15, 1935, any Member may apply without endorsers to the Board of Direction for transfer to the grade of Fellow, and the Board, after satisfying itself of the applicant's qualifications, may transfer him to that grade by not less than an 80% vote of the entire Board. On and after November 15, 1937, transfer to the grade of Fellow shall be upon application favorably endorsed by seven Fellows and approved by not less than an 80% vote of the entire Board or as provided in Article II, Section 2, for recognition of exceptionally distinguished achievement.'

"Amend Article IV—Dues

"Strike out Sections 1, 2, and 3 and substitute the following:

"'1. The entrance fees payable on admission to the Society shall be as follows: by Fellows, thirty dollars; Members, twenty-five dollars; Affiliates, thirty dollars; Junior Members, ten dollars; Student Members, no entrance fee.

"'2. The annual dues payable by members, except those in District No. 1, shall be as follows: by Corporate Members, twenty dollars; Affiliates, twenty dollars; Junior Members, ten dollars; Student Members, three dollars.

"'3. In District No. 1 as hereinafter constituted, the annual dues, except for members residing outside of North America, shall be as follows: Corporate Members, twenty-five dollars; Affiliates, twenty-five dollars; Junior Members, fifteen dollars; Student Members, five dollars.

"'Members residing outside North America shall pay annual dues as follows: by Corporate Members, twenty dollars; Affiliates, twenty dollars; Junior Members, ten dollars; Student Members, three dollars.'

"Strike out Section 6, and renumber Section 7 as Section 6."

PROPOSAL NO. 2

"Amend Article VII, Section 6, second paragraph, by striking out the words: 'printed in the first number of the "Proceedings" issued to the membership after October 15 in each year, and substituting therefor the words: 'published within thirty days after October 15 of each year.'

"The paragraph will then read:

"'The Secretary shall prepare a list of "Official Nominees" showing thereon the name of the person nominated as herein provided for the office of President and the results of the "second ballot" which list shall be published within thirty days after October 15 of each year.'"

Two Members Vindicated

APPRECIATION SHOULD be accorded the Administrator of Public Works, the Honorable Harold L. Ickes, Secretary of the Department of the Interior, for his forthright action in respect to two members of the Society concerning whom he has rescinded his earlier order affecting them adversely.

Robert J. Paulette, M. Am. Soc. C.E., formerly associated with Murray A. Wilson, Assoc. M. Am. Soc. C.E., of Salina, Kans., severed his connection with the firm to accept appointment, in August 1933, as State Engineer for the Public Works Administration for the State of Kansas. Upon the request of the Administrator, Mr. Paulette resigned his position in November 1934. In December 1934 an order emanating from the Administrator advised that the Public Works Administration would have no dealings with Mr. Wilson. Mr. Paulette resumed his business association with Mr. Wilson on January 1, 1935, as the Wilson Engineering Company.

As outlined in the May 1935 issue of CIVIL ENGINEERING, these actions of the Administrator received the earnest consideration of the Kansas State Section of the Society, which referred the matter to the Board of Direction of the Society. Vice-President Henry E. Riggs was assigned to make an investigation, which he did vigorously and thoroughly, concluding that the Administrator had acted on misleading information, with resulting injustice to the two engineers concerned.

His report received the approval of the Board of Direction at its Miami Meeting and, by action of the Board, the Administrator was requested to reopen the cases and grant representatives of the Board a hearing. Vice-President Riggs and Director Henry J. Sherman, as the Board's representatives, placed before the Administrator the evidence which had been accumulated, consisting of affidavits, letters, and other data which warranted the conclusion that the Administrator had been misled by distorted reports.

Quotation from Administrator Ickes' letter of June 27, 1935, reads as follows:

> "I have today signed an order rescinding the order which barred the above firm (Wilson Engineering Company, i.e., Paulette and Wilson) from employment in connection with Public Works Administration projects."

The Board of Direction voted appreciation of the Administrator's action and gratification that he had found it practicable to rescind his former order.

Modification of Work Relief Regulations Urged

LOS ANGELES CONVENTION RESOLUTION POINTS TO LIMITATIONS NOW IMPOSED ON CONSTRUCTION OF USEFUL WORKS

WHEREAS, the Work Relief Program as proposed by the President in his annual message to the Seventy-Fourth Congress and as authorized by the Congress gave promise of relieving the unemployment problem and at the same time creating useful works which would add to the wealth of the nation, and

WHEREAS, the President in a public proclamation immediately after the passage of the Act enumerated the major purposes to be accomplished by the Act, and the Relief Program is now being initiated under rules and regulations which nullify in a large measure the principles enunciated by the President, and

WHEREAS, the rules and regulations as promulgated through executive orders, newspaper releases, and instructions to Bureaus and applicants, render difficult any considerable use of the facilities of private enterprise as set forth in Section Eight of the Act, and

WHEREAS, these rules and regulations will result in the cessation or grave reduction of the permanent works undertaken during the past three years by the War Department, Department of the Interior, Bureau of Public Roads, Bureau of Reclamation, Engineer Corps of the Navy, other Federal Departments and by States and Municipalities, thus throwing out of work those directly employed thereon and also the large numbers of workmen indirectly employed in the production of materials and equipment used therein, and

WHEREAS, the present limitations on the cost of work per man employed, will effectually prevent the construction of useful works under the major categories as established by the Congress in the Act; such as permanent surfacing of roads, grade crossing eliminations, rural electrification, reclamation, non-Federal works and general works of a permanent character, and

WHEREAS, money expended in the purchase of materials and equipment which are necessary for useful works creates indirect employment in industrial centers where the unemployment is greatest and has an indirect but much greater effect on industrial recovery than money expended on work initiated solely on the basis of relief, therefore,

Be it resolved by the American Society of Civil Engineers in Convention assembled at Los Angeles, California, July 3, 1935, that the rules and regulations limiting the amount of money to be expended per person employed, be revised to provide for the purchase of sufficient materials and equipment to permit the construction of useful works which will stimulate recovery and add to the national wealth, and

Be it further resolved, that the American Society of Civil Engineers urges the Administration to carry out the Act substantially in accordance with the terms of the Act itself; in accordance with the President's Annual Message to the Seventy-fourth Congress and with the President's initial statement of purpose and policy; and recommends adoption of rules and regulations which will permit adherence to the allocation to useful works of various characters stipulated in the Act, and

Be it further resolved, that the purport of this resolution be presented to the proper Federal authorities.

July 3, 1935

Mapping for National Planning

In order to emphasize the value of present and proposed mapping activities throughout the country, a pamphlet entitled "Mapping for National Planning" has recently been issued by the Society. This 58-page publication, based on a program presented before the Surveying and Mapping Division of the Society last January, at which time a paper by Frederick H. McDonald, M. Am. Soc. C.E., was read and discussed, dwells upon the important relations of mapping to other national projects. It presents a forceful argument for the beneficial use of mapping in developing national and community planning, in utilizing natural resources, and in everyday commercial progress. In addition, the helpful effects on employment in engineering and planning work are emphasized.

How important this phase of employment may become will be evident to any engineer who can see the possibilities of putting to work untrained men in minor positions, such as rodmen, recorders, and chainmen. Already the government has had unusual success in this type of work, as reported by William Bowie, M. Am. Soc. C.E., chairman of the Surveying and Mapping Division, which has sponsored this report. In his own department of the Coast and Geodetic Survey Major Bowie has employed, in addition to his regular staff, as many as 350 engineers with degrees and over 400 who are graduates in some other field or who have taken college work. In fact, more than half of the 1,560 emergency men employed were engineers or college men. There is also a large group in the U. S. Geological Survey, which has likewise provided a great deal of worth while emergency employment. Because such a large proportion of the work requires the employment of white collar personnel it is apparent that this field presents an unusual opportunity. The pamphlet discusses the possibility of such work and the extent of the planning and mapping that may reasonably be undertaken.

While the pamphlet is intended primarily for the use of governmental officials—federal, state, county, and municipal—it will also make interesting reading for business and professional men. The edition is limited and not for general distribution, but a number of copies have been set aside for the use of those members who may especially desire to study this important topic. Requests for complimentary copies will be filled at Headquarters as long as the supply lasts.

Value of Map Projects Stressed in Resolution by Los Angeles Convention

Whereas, effective planning for the conservation and development of the nation's resources must be based on fundamental data secured through physical surveys and recorded on maps; and

Whereas, at the present time there is, unemployed, the necessary technical personnel to gather and record such data; therefore,

Be it resolved by the American Society of Civil Engineers in Convention assembled at Los Angeles, California, July 3, 1935, that those organizations of the Federal Government charged with the allotment of funds, appropriated under the Emergency Relief Appropriation Act of 1935, be requested to support liberally in a financial way the Federal, State, and Local Agencies (including planning commissions) concerned with the gathering, assembling, and correlation of all data relating to topographic and geodetic surveys and maps; and

Be it further resolved and recommended that the requests for funds which have been presented by the U. S. Geological Survey and the U. S. Coast and Geodetic Survey be approved and prompt allotments made, and;

Be it further resolved, that the purpose of this resolution be urgently presented to the proper Federal authorities.

Convention Party Enjoys Scenic Tour

A tour arranged for the benefit of those going to the Convention from the East and Middle West attracted a group of about 20 persons, including their wives and families and guests. The party left Chicago June 19 in a special Pullman coach, and arrived in Los Angeles June 30. Motor trips were made from Colorado Springs to the Garden of the Gods, Seven Falls, and Cave of the Winds, and from Denver to the mountain parks. An unseasonable snowfall, occurring a week before the arrival of the party, had blocked the Mount Evans highway and made impossible a trip over the highest motor highway in the world.

While the party was in Denver, the Colorado Section held its annual meeting and outing at Boulder, with dinner at Eldorado Springs. The visiting members were extended a cordial invitation to attend, and a number of them were able to do so. Courtesies were again extended at Salt Lake City, where local members lunched with the party and later entertained them with trips to Bingham, a picturesque mountain town, site of the world's largest open-cut copper mine, and to Salt Air Beach on the lake.

The entire party was enthusiastic about its visit to Zion National Park, where park engineering problems were pointed out by A. E. Cowell, park engineer, and T. C. Parker, associate engineer, both Associate Members Am. Soc. C.E., in the course of a special tour they had arranged. At Bryce Canyon National Park the Society group was the first to use the newly completed road leading to hitherto inaccessible parts of this canyon with its fantastic colors.

The special sight-seeing features of the trip were concluded with an all-day inspection tour of Boulder Dam, where powerhouse construction and penstock installation are now in full swing.

Importance of Water Planning Work Pointed Out

SOCIETY CONVENTION FAVORS CONTINUATION OF NATIONAL COORDINATING AGENCIES IN FIELD OF WATER RESOURCES DEVELOPMENT

Whereas, the development and control of the Water Resources of the United States for irrigation, power, flood protection, navigation, public water supplies, soil, conservation, and other beneficial purposes are of vital importance to the well being of the nation, and

Whereas, the collection, analysis and publication of accurate basic information on the quantity, quality and distribution of water resources are essential to the intelligent preparation of coordinated comprehensive plans for their control and development, and

Whereas, the work and activities of the Water Resources Section of the National Resources Board and of the Water Planning Committee thereof, to date, have been of a highly constructive nature, and give promise, if continued on a national scale, of affording the means for planning, in the most advantageous and orderly manner, the development of these national resources, which planning can take place satisfactorily only when directed from a national viewpoint, and

Whereas, many of the beneficial results of coordination of the work of the national organizations in the field of water usage, would be lost if these agencies were disbanded or their functions left primarily to the direction of local and regional or state boards, therefore,

Be it resolved by the American Society of Civil Engineers in Convention assembled at Los Angeles, July 3, 1935, that it is essential that the principles, objectives and activities of the Water Resources Section, National Resources Board and of the Water Planning Committee thereof, be continued within the newly created National Resources Committee, through a distinct agency therein, the duties and sphere of activity of which shall be those heretofore assigned to the Water Resources Section and the Water Planning Committee, and such additional duties as may be necessary to formulate the most orderly plan of development of the water resources of the nation, and

Be it further resolved that the purport of this resolution be urgently presented to the proper Federal authorities.

Interesting Snapshots of Society Developments

Some Excerpts from President Tuttle's Annual Address at the Los Angeles Convention

THE MOST significant impression one gets from a review of the history of the American Society of Civil Engineers is that of the wisdom and vision of its founders. A comparison of the definition of the objects to be attained by the Society, as written into the Constitution of 1852, with the definition in its present form will reveal their sound judgment and their keen appreciation of the responsibilities which the organization should assume. Such a comparison will disclose the remarkable fact that no change whatever has been made other than a re-arrangement of wording.

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During all these intervening years, the Society has continuously observed a conservative, and at the same time, a far-sighted policy. It is to this policy—which, to reiterate, was that of our founders—that we owe our present strong position.

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The first important event came nearly thirty years after the Society was founded; we achieved our first home, a modest building on East 23d Street. The effect of that step cannot be overestimated, for it gave opportunity of increasing usefulness and it assured permanency.

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In 1897, the Society, having outgrown its original quarters, moved to a new house in West 57th Street, one especially designed for its activities. Yet by 1905—after only eight years—this building, too, had been outgrown and an addition to it was erected to care for the rapidly increasing membership.

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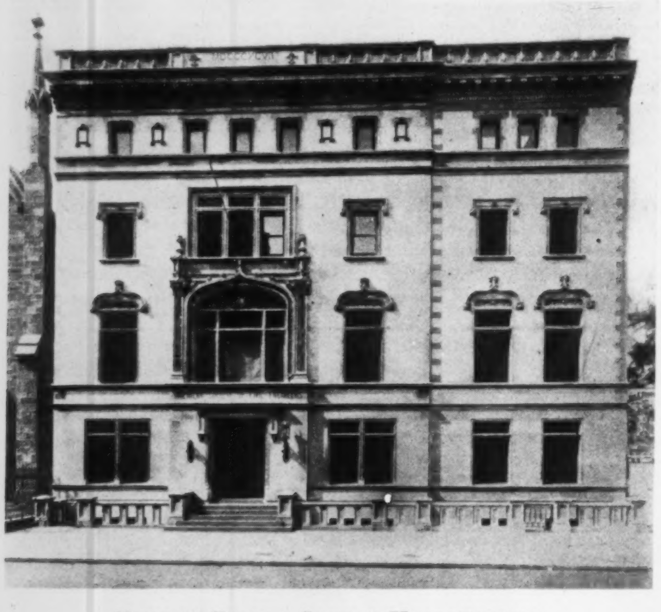
But the Society was concerning itself not only with expansion. Following the ideals of the founders, it was interested also in maintenance of professional standards. Accordingly, in 1914, a Code of Ethics was adopted which has stood the test of time without change other than the addition of one paragraph.



VIEW OF FORMER SOCIETY HEADQUARTERS
220 West 57th Street, New York, N.Y.

In 1916 an agreement was entered into with the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, as Founder Societies, under which our Society in the following year moved its Headquarters to the Engineering Societies Building in West 39th Street and became one of the beneficiaries of the gift of $1,050,000 that had been made by Andrew Carnegie toward the cost of a building originally intended to provide a home for the four National Engineering Societies, which building had been completed and occupied by three of them since early in 1907. This change carried with it a merger of our library and participation in The Engineering Foundation.

More recent administrative changes have been for the purpose of making concrete those ideals which our Society has held from its inception: Expansion, usefulness, maintenance of high professional standards.

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ACTIVITIES

As the work of the Society has gradually expanded there has been a corresponding increase in demand for active service on the part of our membership to the end of putting new activities into successful operation.

From the 1935 Year Book the following statistics as to Committee membership have been developed:

	No. of Committees	No. of Members
Board of Direction (Standing Committees)	6	31
Advisory, Administrative, Professional, and Research	24	144
Technical Divisions	58	453
Joint Boards—Administrative	11	41
Joint Boards—Technical	11	56
Total	110	725

If to this list of active workers there be added the membership of special committees, the total number of assignments to active service in and for the Society, according to Secretary Seabury's estimate for 1935, is over 3,000, approximately 20% of the total. Responsibility of this character must incidentally have a strong influence in developing a spirit of loyalty to the Society on the part of those enlisted in its service, as well as in promoting our professional interests.

The budget for the year 1935 is set up to provide for a total expenditure of $373,000, of which only $213,000 is anticipated to be defrayed from dues—a ratio of $1.75 gross expenditure to each $1.00 collected as dues. Probably few organizations can show anything like such a large return to its members in proportion to their payments.

Other income is derived from the 57th Street property and other investments, advertising, entrance fees, sale of publications, and returns for special services. These and a budget draft of $27,000 from surplus make possible the relatively large annual expenditures.

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LOCAL SECTIONS

The recognition of local associations became a subject of discussion in 1872. The suggestion was rejected in 1882, but was finally approved by the Convention of 1905.

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At the beginning of the present year we had 57 Local Sections with a total membership of 6,254, averaging 110 per Section.

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The value of the Local Section in nationalizing the Society is clearly indicated on the membership diagram (Fig. 1), which shows a marked increase in growth beginning with the date of their first recognition. During the last three years there has been a falling off in membership due to causes readily understandable, but this will unquestionably be corrected with the return of better times.

In order to complete the nationalizing movement it would seem timely and desirable to amend our Constitution and By-Laws so as: First, to provide for definitely assigning each member of our Society residing in the United States or in any of its major possessions, or in Canada, to a Local Section, with provision for at least one such Section in each State or major possession; and second, to secure unity of action on the part of Local Sections in matters of State concern in case there is more than one Section in a State.

Incidentally, this step should be taken in such a way as to make a Local Section a real instrumentality of the Society and, at the same time, give it the maximum of freedom for vigorous participation in local affairs. Under the present Constitution a Section is restricted from speaking for the Society unless authorized by the Board of Direction. This condition, however, should not be construed as otherwise limiting its freedom, provided, of course, that it does not attempt to set up or endorse any policy conflicting with one adopted by the Society or by its Board of Direction.

Inasmuch as the success of such a plan would, at least to a considerable extent, be dependent upon the efficiency of a Section Secretary, it should be coupled with provision for the selection of the Section Secretary by the Governing Boards of the Sections as a paid officer, the selection to be subject to the approval of the Board of Direction of the Society. The salary allowed should be regulated with due regard to the membership in a Section, and it should have the psychological effect of imposing a recognized responsibility upon the holder of the office.

Functioning in this way, there would be brought to every member what Past-President Eddy has happily termed "Society consciousness," and irrespective of location the Sections should develop in such a way as to stimulate the feeling that their members are an essential agency of this Society and of the profession as a whole.

Through Section efforts and the proposed State combinations, and guided by our Board of Direction, the Local Sections should become agencies for increased usefulness and value both to individual engineers and to the public, and the prestige of our profession would inevitably be enhanced. There should be no doubt but that this increased expense would result in a widened interest in the affairs of the Society, and it is more than likely that it would soon attract enough additional members to fully justify the cost.

STUDENT CHAPTERS

In 1920 the Board authorized the formation of a Student Chapter at Stanford University, an action which was followed by the formation of eight more Chapters in the same year and by the amendment of our By-Laws in 1921 to provide for their recognition and government. By the close of 1923 there were 63 such Chapters in existence, or more than one-half the present total of 111. Two of the 111 Chapters were formed only this year. The rapidity with which advantage has been taken of this opportunity to participate in our activities is amazing and is also abundant evidence of the existence of a real field for development and service.

The size of these Student Chapters, too, is significant. At the present time, eight have a membership of over 100, the largest being the one at the University of Wisconsin, with 169 members.

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This student body, now over 4,300 in size, should serve as a recruiting source for our Society to make up necessary replacements and maintain our growth. That it has functioned in this way is evident from an inspection of the accompanying chart showing the Junior membership in the Society since 1910, and also the Student Chapter membership since 1920, when Chapters were first organized. Such falling off in Student Chapter membership as there has been during the last three years, is clearly due to the depression (see Fig. 2).

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Over 60% of our membership gain since 1926 is made up of men in the Junior grade.

The membership chart also shows that the increase in the Junior grade brought about by the recognition of Student Chapters has been much more steady than that of the Society as a whole, and that the effect of the depression is less pronounced. It is also to be noted that our Juniors now constitute more than one-fifth of the entire membership, and we can take pride in having this substantial base for an enduring growth.

In view of the recognition so markedly extended by our engineering schools as to the value of the Student Chapter to them, it would seem desirable to place a larger and more direct measure of responsibility upon an accredited teaching institution for maintaining and governing the Chapter, rather than upon the individual members, and to require membership in it on the part of all registered students.

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TECHNICAL DIVISIONS

It is now apparent that insufficient encouragement was accorded by our Society in the early years to those not practicing more particularly in the general field of Civil Engineering, with the result that new organizations were brought into existence to serve other branches of the profession. Several of these represent highly specialized groups, while others are open to men without technical training, the existence of either of which conditions would seem to preclude any possibility of merger with any of the Founder Societies.

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With continued expansion of the Technical Division activities it should be possible to serve in one organization the technical

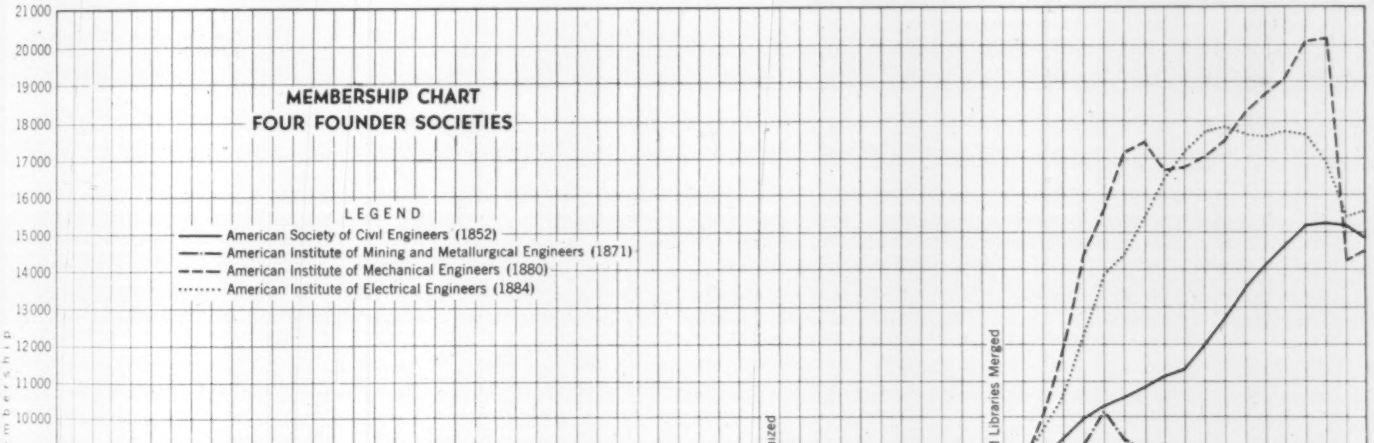

FIG. 1. TRENDS OF MEMBERSHIP, FOUR FOUNDER SOCIETIES, SINCE 1870

needs of all Civil Engineering specialists, and thus check the movement toward the creation of new and independent agencies in these and other engineering fields, to the end that through combined effort a maximum of efficiency may be developed.

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FINANCIAL

The report of the Board of Direction for the year 1934 shows net worth as of December 31 greater than at any time in its history, and as follows:

Cash and other liquid assets	$ 26,858.32
Marketable securities at market	25,881.67
Accounts receivable, less doubtful accounts	14,096.03
Publications and prepaid insurance	14,937.76
Furniture	6,122.06
Real estate, West 57th Street	597,638.84
Share in joint holdings—West 39th Street property	493,352.60
Library	94,433.05
Special funds (book values)	145,731.33
Net worth	$1,419,051.66

The special funds are all conditioned in such a way as to be used for purposes consistent with the activities of the Society.

The assets of the Society in 1892, or five years before the 57th Street house was occupied, were estimated at $60,000. The increase in value during the following 25 years was $700,000, making a total of $760,000 in 1917, when we removed our quarters to West 39th Street. This remarkable increase was partly due to contributions to the West 57th Street Building Fund, partly to sharing in the gift of Andrew Carnegie to the Founder Societies, and partly to excellent management. The further increase of nearly $660,000 during the period between 1917 and the beginning of this year, is chargeable partly to the estimated increase in the value of the West 57th Street property, which is probably still appraised at very much less than its selling value in a normal real estate market, partly to income from the property, partly to gifts, and partly to the policy which was long maintained of balancing the budget with a safe margin.

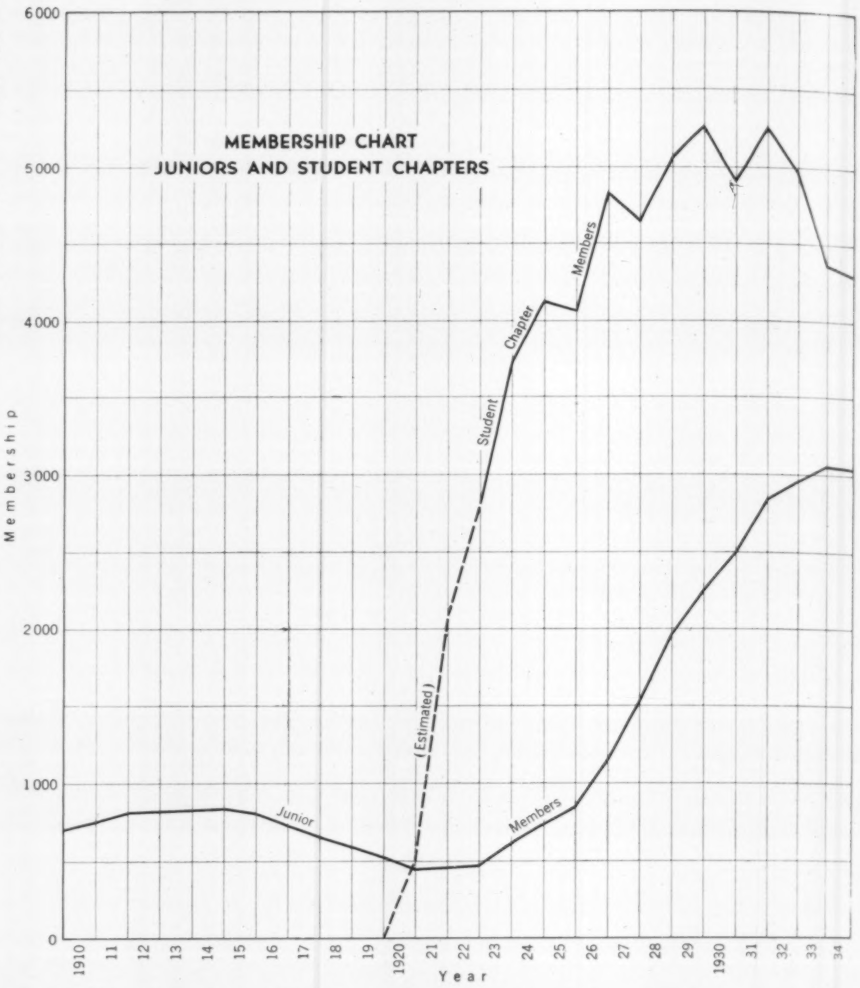

FIG. 2. INCREASE IN NUMBER OF YOUNGER SOCIETY MEMBERS; GROWTH OF JUNIORS AND STUDENT CHAPTERS COMPARED

With the coming of the depression and the recognition in 1931 that members in many instances would be unable to pay their dues, the budgets for that year and for the succeeding years, 1932, 1933, 1934, and 1935, have all been set up with an anticipated draft upon surplus, in order that the essential activities of the Society might be maintained, and in order that there might be no substantial curtailment in usefulness during these serious times. Budgeted drafts upon surplus have been as high as $40,000, but due to various economies effected, the actual drafts in various years have been of lesser amount. The increase in dues in the year 1934 and thus far in the year 1935, and the increase in applications for membership, indicate the response made by the members and the profession to the work done in their behalf.

It is also particularly gratifying to note that during 1934 the final payment was made on the mortgage on the West 57th Street property, leaving the Society entirely free of debt and fixed charges, and that for the first time since the depression set in, more applications for admission were presented in 1934 than in the year preceding—a condition which the record for 1935 shows to be continuing.

For the year 1935, to permit of further expansion in efforts to serve members even more extensively than ever before, new activities have been undertaken which will again unbalance the budget to an estimated amount of over $25,000. But if history repeats itself, this money will flow back into our treasury in the course of time through revenues from increased membership, payment of back dues, and reinstatements. In any event, the Board of Direction has deemed it wise to adhere to the policy of increasing activities in every direction during these troublous times when substantial assistance could properly be given to the betterment of the present status of our members.

Looking back over our record, we can detect the outstanding events that have shaped a progress which has continuously been one of conservatism tempered with common sense, and can see that the more sweeping changes have each marked a period of increasing strength. Among these stand out the progressive betterments in quarters and in library facilities, the recognition of Local Sections, the setting up of Student Chapters, the creation of Technical Divisions, the publication of CIVIL ENGINEERING, and the expansion of interest in human problems of direct concern to the individual.

At no time has the Society gone out to seek for members, its recognized value being so great to the practitioner as to bring applicants for admission on their own volition to our doors.

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Our position is a strong one, and we can face the future with confidence in continued progress toward the achievement of all the Society stands for—the advancement of our profession and of the interests of its members, and usefulness to our fellow man.

Society Looks Forward to Fall Meeting in Dixie

BIRMINGHAM, Ala., industrial city of the South, will be host to the Society on the occasion of its fall meeting, which begins on Wednesday, October 16. Special sessions are being arranged by the Sanitary Engineering, Construction, Highway, Surveying and Mapping, and Structural Divisions.

Two days of general and Technical Division meetings are to be followed by two days of inspection of nearby points of engineering interest. One trip already planned will be an all-day excursion to the mines, quarries, and steel works of the Tennessee Coal, Irno, and Railroad Company, where members and guests will have an opportunity to see all operations in the manufacture of iron and steel.

Special entertainment is to be provided for the ladies during the business hours of the convention, and there will be mixed social affairs in the evenings.

Members going to the meeting from the North will have an opportunity to visit Wheeler Dam, now being built in northern Alabama, and those whose route can be arranged through Knoxville, Tenn., will have to make only a short side trip in order to inspect Norris Dam, which is also under construction.

Booklet on Masonry Dam Sections Reprinted

SINCE ITS original publication by the Society in the Fall of 1934, the pamphlet giving Cross Sections of Masonry Dams on Earth Foundations has been in great demand. It has now been reprinted, and a supply is in stock to meet the needs of those who have been disappointed in the exhaustion of the previous issue before their orders were filled. The pamphlet is supplementary to the paper on "Security from Underseepage—Masonry Dams on Earth Foundations" by E. W. Lane, M. Am. Soc. C.E., published in the September 1934 PROCEEDINGS.

Its over-all size is 40 pages, including 22 pages of dam sections, 8 pages of bibliography, and a complete index tying the sections into the references in the main paper. The 166 sections given comprise a complete file of details of this type of structure. Its printing evidently met a real need inasmuch as the entire original edition was quickly exhausted and the Society has for a number of months been unable to satisfy additional requests.

A number of advance orders are already in hand. On this basis the new supply has been secured in quantity to maintain the price at its original figure, 50 cents per copy. Orders will be filled through the Headquarters of the Society, 33 West 39th Street, New York, N.Y.

Sharpen Your Wits by Discussion

IN EFFECT, THE PROCEEDINGS of the Society is an open forum to which active-minded members of the profession may come for "a meeting of the minds" on advanced technical questions. Membership in the Society, as defined by the minutes of its first meetings (and reiterated many times in the succeeding 80 years), implies a definite obligation to contribute information that may add to the growing store.

Ideally, a writer with new information offers his argument for discussion; those qualified to do so proceed to "shoot holes" in the argument or to come to its defense; and the author summarizes the total mass of evidence and presents his conclusions. Every progressive civil engineer studies the papers in PROCEEDINGS that treat his special field.

Not everyone can spare the time for the careful research represented by the papers published in PROCEEDINGS. Few there are, however, who cannot find time to prepare a letter, to be published as a discussion. The criteria for acceptance of discussions are fairly liberal, being based on the principle that words of wisdom can come from young and old, and that every responsible person is entitled to have his opinions presented, provided that they bear definitely on the subject matter of the paper itself and that he makes a serious effort to support them.

It has been found to be poor policy to let discussion languish, in desultory manner, over too many months. When the advertised closing date does not afford sufficient opportunity to discuss any paper, a person can usually have it extended a reasonable time, if he will only notify headquarters as to the approximate date when his contribution may be expected. An article that will be helpful in preparing material for PROCEEDINGS, was published in CIVIL ENGINEERING for October 1934 (page 549). A limited number of reprints are available on request.

Secretary's Abstract of Executive Committee Meeting

AT THE AMBASSADOR HOTEL in Los Angeles on June 30 and July 1, 1935, the Executive Committee met in advance of the Board Meeting. Present were: Arthur S. Tuttle, President; George T. Seabury, Secretary; Alonzo J. Hammond, Past-President; and Messrs. Hogan and Sawyer, Vice-Presidents.

Approval of Minutes

The minutes of the meeting of the Executive Committee held on April 3, 1935, were approved.

National Planning Compels National Mapping

A document presented by the Executive Committee of the Surveying and Mapping Division, emphasizing the value of topographic maps, was ordered printed and distributed for the special use of federal, state, county, and municipal officials, as well as business and professional executives.

The publication of this document will show the need for detailed and comprehensive topographic maps as an essential for national and regional planning, the utilization of natural resources, and the everyday development of community, industrial, and commercial projects.

Civil Engineers and the Society to Be Publicized

As instructed by the Board at its January meeting, the Executive Committee adopted certain procedures whereby the work of civil engineers and of the Society is to be brought more prominently to the attention of the public. Experts will be retained to provide wider publicity in connection with the several meetings of the Society, and a systematic and continuing distribution to the press of items of civil engineering interest or character will be initiated.

Juniors on Committees

The progress made in appointing, wherever practicable, Juniors to Society, Division, and Local Section Committees was reported to the Executive Committee. Nine of the Local Sections report that it has been their practice for some time to appoint Juniors on their Committees. Others report the activities of a Junior Forum, sponsored by the Sections. The Forums have their own meetings in some Sections, holding joint meetings frequently; and at times, the entire Section meeting is delegated to the management of the Juniors.

Financial and Administrative Details

Approval was given to the sale and purchase of certain of the securities wherein the Society's funds are invested. Recommendations were made to the Board concerning certain new appropriations and several financial and administrative details.

Meeting of Board of Direction—Secretary's Abstract

ON JULY 1 and 2, 1935, the Board of Direction met at the Ambassador Hotel, Los Angeles, Calif., with President Arthur S. Tuttle in the chair; and present George T. Seabury, Secretary; and Messrs. Ammann, Burdick, Crawford, Dewell, Etcheverry, Ferebee, Hammond, Hogan, Horner, Leisen, McDonald, Morse, Noyes, Perry, Reed, Riggs, Sanborn, Sawyer, Sherman, Stabler, Trout, and Wilkerson.

Approval of Minutes

The minutes of the meeting of the Board of Direction held on April 3–4, 1935, were approved.

The minutes of the meeting of the Executive Committee held on June 30 and July 1, 1935, were also approved, and the actions outlined therein were adopted as the actions of the Board of Direction, with the exception of certain matters on which recommendations made to the Board were considered and acted upon separately.

1936 Meetings

The 1936 Annual Convention will be held in Portland, Ore., and the 1936 Fall Meeting at Pittsburgh, Pa. Decision as to whether there would be a Spring Meeting and where it would be held was deferred.

Employment of Engineers

The Board was informed of the relations which officers of the Society had had with Federal authorities, more especially those of the Works Progress Administration, in relation to the engagement of engineers in connection with the Emergency Relief Appropriation Act of 1935.

Several methods whereby the services of engineers may be engaged for the design of engineering projects and the technical supervision of their construction had been outlined and draft of an engineering administrative agreement proposed. In general, the agreement where the fee is based on the cost of the work, as under normal conditions, was endorsed; but when engineers or engineering assistants are to be found on the relief rolls, or unemployed, an administrative agreement providing recompense on an out-of-pocket basis, plus a moderate amount for the administrating engineer's personal services was deemed practicable, especially on relatively simple engineering projects, the construction cost of which is not great.

Committee on Aims and Activities

The Committee on Aims and Activities made its second report to the Board. The committee had continued correspondence since its previous meeting and came together on Sunday, June 30, at Los Angeles. Its report reviewed the progress which had been made with respect to its former recommendations.

To the committee had been submitted a proposal that the Local Sections be reorganized along state lines. The committee definitely recommended against such a reorganization. Upon its recommendation, the Board approved the renewal of the Local Section Conferences, the first to be held at Birmingham during the Fall Meeting. Representatives from the Sections within the Southern Meeting region are to be allowed mileage at the rate of 5 cents per mile one way.

The committee recommended its own discharge and the establishment of a continuing Committee on Aims and Activities, to be composed of nine members, the terms of three of whom would expire annually. Three of the members of the Committee are to be Board Members, the others Corporate Members of the Society, not Board members. The function of the permanent committee is to initiate, to energize, and to develop Society policies looking toward the betterment of the professional and economic status of the membership. It is to be advisory to the Board. The Board adopted the recommendation of the Committee, making the necessary appropriation.

Chairman Perry, in speaking of the work of his committee, stated that the Committee was unanimous in its decision that the problems of the Local Sections should receive the first consideration of the new committee, in studying which it would be greatly benefited by the observations now being made by Field Secretary Jessup in his visits. Mr. Perry outlined several possibilities that would be of great benefit to the Society and its membership if it should be found practicable to finance them.

Defense of Members

It was reported to the Board that the defense of two members which it had instituted had resulted satisfactorily. Details of this experience appear elsewhere in this issue. The hearty thanks of the Board were tendered Vice-President Riggs for the very active and earnest efforts on his part that had made possible the successful outcome.

Works Relief Program, Water Resources, Mapping

Three resolutions relating to the administration of the Emergency Relief Appropriation Act of 1935 were drafted and approved by the Board for Adoption by the Society at the Business Meeting of the Annual Convention.

The resolutions urged revision of the rules and regulations now operative in respect to expenditures so as to permit of useful public works going forward in normal manner; continuance of the program developed in relation to the water resources of the nation; and acceptance of an expanded program of national mapping by the U. S. Coast and Geodetic Survey and the U. S. Geological Survey. These resolutions will be found elsewhere in this issue.

Selling of Plans and Specifications Condemned

The Board adopted the following resolution relative to the selling of plans and specifications as practiced by some engineers.

"The Board of Direction of the American Society of Civil Engineers condemns the practice of selling plans and specifications. The customary practice is to require refundable deposits.

"It is recommended, therefore, that a reasonable sum be required from each prospective bidder for one set of plans and specifications, this charge to be refunded on their return in good condition. If additional sets are needed a reasonable non-refundable charge may be made."

Committee on Professional Conduct

The Committee on Professional Conduct reported on seven matters which had been referred to it for consideration. The Board considered some complaints not to have been convincingly demonstrated, advised one member his conduct was unsatisfactory, exonerated another against whom complaint had been made, and continued its study of other cases.

Constitutional Amendments

The Board considered several features relative to the proposed constitutional amendments. One change was determined upon, one interpretation made, and a call issued for a meeting of the Society to canvass the ballots in New York on October 16, 1935. This meeting will not interfere with the Fall Meeting to be held at Birmingham, on the same date, the New York meeting being called solely for the purpose of this canvass as a matter of convenience in the opening and counting of the ballots.

The change in Amendment Proposal No. 1 was voted by the Board as a recommendation to the Business Meeting at the Annual Convention where it was adopted by the Corporate Members present. The change proposed and the amendment proposal as amended by the assembled Corporate members appears elsewhere in this issue with the interpretation of "active practice" adopted by the Board.

Publicity

Upon the recommendations of the Committee on Publications and the Committee on Public Education, the Executive Committee developed a program of publicity which it recommended to the Board and which the Board adopted. Details will be found elsewhere in this issue.

Additional Appropriations

Acting upon requests for various specific purposes the Board considered and approved several additional appropriations for Society work.

Committee Reports

A number of regular reports were received from Board committees and appropriate action was taken in each case.

Official Visits

Many visits on Society business by officers were reported, as noted in an item elsewhere in this issue.

Miscellaneous Matters

Additional matters of administrative character were presented, discussed, and acted upon.

Adjournment

The Board adjourned to meet in Birmingham, Ala., on October 14, 1935.

Publicity of the Society and Its Membership

THE DETAILS of a two-phase publicity program have been worked out by the Executive Committee in collaboration with the Committee on Publications and the Committee on Public Education, under the chairmanship, respectively, of Henry J. Sherman and Abel Wolman, Members Am. Soc. C.E. These two committees will have administrative charge of the work.

BRINGING SOCIETY AFFAIRS TO SOCIETY MEMBERS

The Committee on Publications proposes to expand CIVIL ENGINEERING in several of its departments as follows:

Maintain the present enlargement of the "Society Affairs" department of CIVIL ENGINEERING, as nearly as practicable.

Insert in prominent position in "Society Affairs" department a "box" or some other device wherein attention will be called to specific details as being worthy of special attention.

Induce in "Society Affairs" department, intimate statements by appropriate committee chairmen or other authoritative members, in support of policies approved by the Board—these statements to be accompanied by portraits of chairmen, officers, or others participating in the development of the policies, reports, or procedures approved.

Induce in "Local Sections" department accounts of selected Local Section activities, more particularly those of non-technical character, accompanying same with portraits of the Local Section officers, committee chairmen, or members of the committee intimately concerned.

Expand "News of Engineers" department, which is now based upon "Correspondence and Society Files," by noting more extensively, accompanied by portraits, the appointment of members to public commissions, or other public bodies, emphasis to be placed upon the work which is to be done in the new position, rather than upon the past history of the member. There may be included in this department, also, expanded items relating the citations or other features incident to honors accorded to members as engineers or as reflecting honor on the engineering profession.

Expand "Student Chapter News" department so as to permit featured items of special activities accompanied by photographs, names of students participating, etc.

Bringing the Civil Engineer to His Public

The Committee on Public Education will have administrative charge of an experiment along the following lines, to:

Carefully prepare and distribute to the newspapers in their respective home cities or vicinities, at the time of the election of new officers, their portraits, an historical account of their work, and such other local features as can be developed.

Make similar distribution, with respect to their home cities, of data relating to Society prize winners and Society appointees.

Carefully prepare and distribute to newspapers in their home cities in connection with each meeting of the Society, portraits of the speakers, combined with a short account of the more striking features of their papers.

Intensify by retained publicists, local publicity in the city where meetings are held giving meeting details, the names of the principal speakers, the topics and subject matter of their papers, and feature some of the more prominent Society members in attendance.

Mimeograph and distribute at intervals of perhaps twice a week to all the newspapers of the country, small items of engineering interest as developed by a retained publicist.

Annual Convention Business Meeting—Secretary's Abstract

Regularly, twice each year, by provision of the Constitution, the Corporate Members of the Society, as such, are afforded the opportunity of taking action by vote of those present. These two occasions are the business meetings held at the time of the Annual Meeting and at the time of the Annual Convention.

The Constitution also provides that amendments to the Constitution "shall be in order for discussion at the Business Meeting during such Annual Convention" (or Annual Meeting). Accordingly the two proposed constitutional amendments, as printed and sent to all corporate members "at least twenty-five days previous to the Annual Convention," came up automatically for action at the Business Meeting held in Los Angeles, July 3, 1935.

Proposal No. 2 permitting the list of official nominations for the Society's offices to be printed in Civil Engineering and omitted from Proceedings, as at present prescribed, received no comment and will go to ballot as proposed.

Proposal No. 1, which provides for changes in the Society's membership grades, was discussed. Upon recommendation of the Board of Direction, the provision that ten years in the Member grade be a prerequisite for admission to the grade of Fellow, except on the basis of exceptionally distinguished achievement, was amended, without dissenting vote, to require only five years in the Member grade. There being no other amendment voted, the amendment as originally proposed will go to ballot with this change.

There was only slight participation in further discussion of this proposal. As against the proposal, query was raised as to the general value of the proposed changes, in view of the fact that there would be a hardship imposed on those now in the Member grade and not qualified for immediate transfer to the proposed grade of Fellow. The President was empowered to appoint a committee to prepare a statement supporting this point of view, the statement to accompany the ballots when issued. Support of the proposal was given in behalf of the elimination of the term "Associate Member."

Upon recommendation of the Board of Direction, three resolutions were adopted. These resolutions, appearing in full elsewhere in this issue, endorsed to the appropriate federal officials, the collection, analysis, and publication of information relative to the country's water resources and the establishment of an instrumentality to correlate the work of the various agencies now in the field of water usage; the full support financially of the requests for funds presented by the U. S. Coast and Geodetic Survey and the U. S. Geological Survey in order that they may carry on an expanded national surveying and mapping program; and the revision of the rules and regulations recently promulgated with respect to the expenditure of the $4,880,000,000 authorized under the Emergency Relief Appropriation Act of 1935.

This latter resolution lays stress upon the desirability of continuing the construction of "useful" works, such as permanent surfacing of roads, grade-crossing eliminations, rural electrification, reclamation, non-federal and general works of a permanent character, wherein there is properly involved the purchase of materials, the use of equipment, and the employment of skilled workmen on the site and in the industries manufacturing and transporting supplies.

Each resolution, presented separately, was moved to adoption, seconded, discussed, and carried without dissenting vote.

There being no other business proffered, the meeting adjourned.

Society Meeting Places for 1936 Allocated

In view of the growing interest of members in attending Society meetings, as evidenced by the large attendance at the recent well-arranged gatherings, the choice of meeting places for 1936 is bound to command attention. A number of invitations from various cities were presented to the Board of Direction at its Los Angeles meeting. From these, Portland, Ore., was chosen for the Annual Convention in the summer of 1936, and Pittsburgh, Pa., for the Fall Meeting.

Only once before has the Society met in the State of Oregon. This was also in Portland, the date being 1920. The occasion was then, as now, the Annual Convention. Pittsburgh was the scene of the Seventh Annual Convention in 1875, but not until 1916 did the Society return for its convention. Both of these meetings were in June. In this connection, the proposed date for the 1936 visit, in the autumn, seems more convenient and more likely to meet with propitious weather conditions.

With the decisions for the 1936 meetings made—no action was taken on the Spring meeting, always assigned to Zone II, because the 1935 Fall meeting is already scheduled for the Southern district, at Birmingham, Ala.—arrangements will immediately go forward in preparation. Local groups and Society officials will put their heads together, and the details of the meetings themselves will begin to take shape.

One of the secrets of past success in meetings is in this very preparedness. Hotel accommodations, for example, are not readily obtained to the extent demanded by such meetings, where often a majority of the facilities have to be assigned to Society use. Reservation a year in advance is none too soon. A guarantee of the success of the 1936 Society meetings is therefore implied in these early decisions to visit Portland and Pittsburgh.

Oldest West Point Graduates

Recently a discussion has been current in the daily press, relative to the honor to be accorded to this or that individual as being the oldest graduate of the U. S. Military Academy at West Point. Apparently two members of the Society are distinguished by a position among the oldest ten graduates.

Second on the list in terms of age and third in date of graduation is Lewis M. Haupt, M. Am. Soc. C.E. While Robert Fletcher, M. Am. Soc. C.E., is in ninth position as to age, only four men precede him in academic position. Dr. Fletcher joined the Society in 1874, which date gives him senior rank among all members, whereas Dr. Haupt's association began in 1888. Their years of graduation from West Point were 1868 and 1867, respectively, according to press reports.

Work of Engineering Functional Units Outlined

AT A MEETING of the joint organizations of the National Engineering Societies, held in New York City on May 20, 1935, addresses were delivered, describing principally recent aspects of the work of these eight joint functional units. Abstracts of four of these papers, namely, those dealing with the United Engineering Trustees, Inc., the Engineering Societies Library, the Engineering Foundation, and the American Standards Association, appeared in the July issue of "Civil Engineering." Abstracts of papers on the remaining four joint units, namely, the National Research Council (Division of Engineering and Industrial Research), the Engineering Societies Employment Service, the American Engineering Council, and the Engineers' Council for Professional Development, are here presented. In addition, there is included an article entitled "Industrial Prospecting," by the chairman of the Division of Engineering and Industrial Research, which was read at the meeting.

THE DIVISION OF ENGINEERING AND INDUSTRIAL RESEARCH OF THE NATIONAL RESEARCH COUNCIL

By D. S. JACOBUS

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THE PURPOSES OF the Division of Engineering and Industrial Research of the National Research Council are to encourage, initiate, organize, and coordinate fundamental and engineering research in the field of industry, and to serve as a clearing-house for research information of service to industry. In its primary functions the Division of Engineering and Industrial Research attempts to maintain a balance between: (1) the demonstration of research methods and technics through large, national, research projects representative of the major fields of engineering; (2) the promotion of research in the field of industry, largely through trade associations by such methods as addresses, literature, meetings, conferences, radio talks, and research laboratory inspection tours; and (3) a research information service.

Because of its plan of organization as part of the National Research Council, the Division is especially fitted to bring together scientists and technologists, who are able and willing to contribute the variety of knowledge and experience requisite for successful attack on research problems. Its quasi-governmental status makes it possible to obtain the cooperation of the various departments of the government, universities, and technical societies, as well as the other divisions of the Council. Industrial cooperation has been utilized to an extent which would not be obtainable by many organizations. In a national emergency, the Council stands ready as a national advisory service organization to mobilize scientific, engineering, and technical resources for the public interest.

Division membership is largely comprised of representatives from national engineering societies. It cooperates with the Engineering Foundation, which furnishes it office space in the Engineering Societies Building and assists it, as well as the Council, in many ways. The Division is not only in touch with the 1,600 industrial research laboratories in this country but is also in correspondence with 100 laboratories in the principal research centers abroad. Through these it maintains constant contact with universities, trade associations, and private research laboratories. The Division depends on interested industry for support of specific research projects. Its administrative expenses are paid from endowment funds of the council.

Successful utilization of research methods, technics, and apparatus, and selection of personnel is demonstrated by the Division's committees and projects. In organizing research committees three types of personnel are drawn upon: scientists to lay out the research program, engineers to develop tests, and industrialists to direct industrial applications.

The Highway Research Board demonstrates the functional operation of the Division. Features of this project include a national clearing-house for highway research data; coordination of federal and state highway research activities; development of new university research centers in the highway field; and distribution of highway research abstracts to stimulate industrial research and eliminate duplication. Other Division projects include electrical insulation, heat transmission, industrial lighting, and relationships between university research and industry.

Promotion of industrial research requires experimentation to develop effective methods. The trade association has proved to be the most effective channel for reaching an industry as a whole. After conferring with those in the industry who are particularly interested, the Division recommends the appointment of a small research committee. Research committees have been taken on a tour of inspection to successful research laboratories operating in the same or closely allied fields of industry. The Division continues to serve in an advisory capacity, if requested. Some industries with which the Division has successfully developed cooperative research activities include: Brick and clay, chemical, combustion utilities, fisheries, gas, glass container, lithographic, porcelain enamel, cotton textile, and commercial aviation.

Further study under government agencies has opened new fields of research. An average of 30 articles and addresses a year is prepared and delivered by officers of the Division. The resulting action has been evaluated in terms of Division objectives. The comparative effectiveness of the address, article, popular science radio broadcast, and motion picture has been developed as an implement for the promotion of research.

In connection with an attempt to bridge the gap between university and industry research, a committee on relationship between university and industry was organized to hold eight regional university conferences. University contacts with industrial laboratories were established. Through such a common pool the resources, facilities, and personnel of university laboratories are made available to the specific research needs of industry.

Two inspection tours of representative research laboratories were arranged for a number of executives and bankers who contemplated establishing research laboratories or expanding them. The first tour exemplified research as conducted by large industrial companies of widely diversified fields; the second was made through smaller laboratories.

Two unusual projects demonstrating the Division's services in organizing scientists and engineers for national and international movements will be mentioned. The American Committee of the World Engineering Congress, held in Japan in 1929–1930, was organized by the Division in cooperation with the National Engineering Societies. The Council arranged for a number of the members of the American Committee to participate in the congress as official delegates from the United States Government. A representative group of distinguished engineers and their families numbering 225 attended, and 80 papers covering significant engineering achievements were presented.

The other project consisted of assisting in the formation of a Science Advisory Committee and of 34 subcommittees, with a total membership of 400, in connection with the Chicago "Century of Progress Exposition." During two years' activity, the Science Advisory Committee submitted to the public reports covering recommendations for the basic philosophy and thousands of exhibits for interpretation of pure and applied science.

An increasing volume of inquiries on all research subjects makes it necessary for the Division to be geared to shifting trends and significant movements in research. Surveys are continually being made to obtain facts from industry on research expenditures, types of problems, significant trends and emphasis in research programs, trade association research, and the effect of the depression on research activities. This material was published and distributed by the Division to libraries, trade associations, government bureaus, and foreign laboratories. Research data have been supplied to research directors to assist in presenting a case to their board of directors to maintain research appropriations.

A supplementary activity of the Division is the administration of grants-in-aid in engineering and industrial research. Some fields covered by the National Research Council grants-in-aid include welding, electrical insulation, radio, highway, and cement. The recent policy of the Council, after consultation with the Division, indicates that grants-in-aid will be available only in engineering and industrial research where the lack of industrial support is demonstrated.

In connection with the National Recovery Administration, President Roosevelt issued an executive order creating "a Science Advisory Board with authority, acting through the machinery and under the jurisdiction of the National Academy of Sciences and the National Research Council, to appoint committees to deal with specific problems in the various departments." The Division has continuously served the Science Advisory Board since its inception. It has materially assisted in the development of such projects as coordination of railroad research, decentralization of industry, patent system as related to new industries, technological reports of foreign commerce officers, radio signaling to avoid collision in fog at sea, and the coordination of scientific and technical activities in the Department of Commerce.

ENGINEERING SOCIETIES EMPLOYMENT SERVICE

By George T. Seabury

Chairman National Committee
Secretary, American Society of Civil Engineers

In 1918 the Engineering Societies made their first joint effort toward the establishment of an employment office. The service was managed by a board made up of the secretaries of the four Founder Societies, and the funds for its maintenance were provided by the Societies. Prior to 1918, each of the four national engineering Societies had operated free employment services for their members for various periods. On January 1, 1921, the management of the bureau was taken over by the Federated American Engineering Societies and was known as the Employment Service for that organization

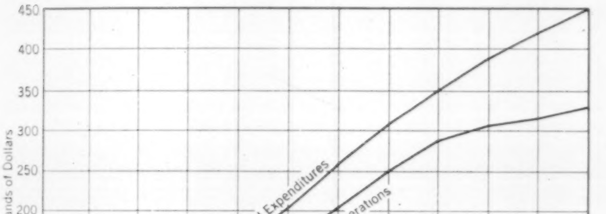


Fig. 1. Income and Expenditures

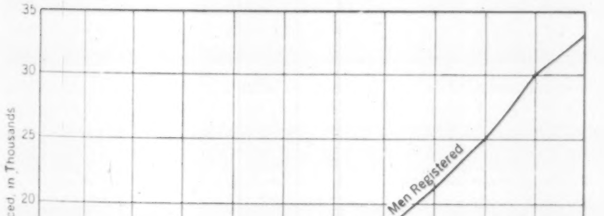


Fig. 2. Men Registered and Placed

Later, in 1923, the management was taken over by the Founder Societies, the boards of direction inaugurating a new policy respecting the Service. This action was based on the report of a joint committee, representative of the four societies, which recommended among other things a cooperative plan of operation. Under this new arrangement, free service was discontinued in favor of a plan to be financed in part by the societies and in part by those who benefited in having received positions through the efforts of the Service.

This plan also called for the establishment of offices throughout the country, as conditions permitted, so that in time the Service might become more truly national in scope. Pursuant to this policy, an office of the Service was opened in Chicago in 1925. This was administered by representatives from the local sections of the Founder Societies in Chicago, in cooperation with the Western Society of Engineers, which assisted in its financial support. Another office was opened in San Francisco in 1926, this office being administered by representatives from the local sections of the Founder Societies in San Francisco and being in financial cooperation with the California section of the American Chemical Society and the Engineers' Club of San Francisco. The New York office differs from the other two offices in that its administration has been assigned to the assistant secretaries of the four societies.

The direction and management of the several offices of the Employment Service as a whole is under a board consisting of the four national secretaries. This board allocates the funds to each of the offices in accordance with the needs, sees that the policies as established are carried out, and otherwise acts as the executive head for the entire joint enterprise.

Use of the Service is confined to the members of the four national societies and cooperating organizations. The establishment of three offices has enabled an exchange of positions and the publication of bulletins of positions available for the use of members seeking opportunities, thus accomplishing in part the function of making the Service more truly nationwide.

In normal times, the Employment Service is self-supporting and in exceptionally good times, such as prevailed from 1927 to 1929, it was able to build up a surplus to help meet such conditions as have prevailed since 1930. During the past five years there has been a dearth of employment opportunities and a great reduction in the normal income received through placement contributions, with the result that this surplus has been exhausted and a large proportion of the cost of operating the three offices has been borne by the Founder Societies.

Something of the effectiveness of the Employment Service may be gaged by the fact that for the $11^1/_4$-year period, from 1923 to 1934, inclusive, 33,372 engineers have been registered in the three offices, 28,721 positions have been received for filling, and 13,870 placements have been made. See the accompanying graphs.

This is indeed a remarkable showing when it is considered that about 25 per cent of the combined memberships of the Founder Societies have been assisted by the Service upon one or more occasions. In view of the extent to which the Employment Service has served the members as well as the needs of employers in all phases of engineering and industry, it appears that this activity should be continued, improved, and expanded.

AMERICAN ENGINEERING COUNCIL

By John F. Coleman

President of American Engineering Council
Past-President, American Society of Civil Engineers
Consulting Engineer, New Orleans, La.

The American Engineering Council was organized in November 1920, to act as a central agency for groups of organized engineers throughout the country. Its membership includes national engineering societies, representing various branches of the profession, and state the local engineering organizations. The Council does not direct the activities of its members, but is a service unit providing a clearing-house for information, including employment sources, a forum for the deliberation of joint problems, and a means by which engineers may express themselves collectively on public problems.

Some 60,000 engineers are represented by the American Engineering Council at the present time, through 7 national, 9 state, and 25 local societies.

We are rapidly establishing ourselves as the "Washington Embassy" of American engineers and engineering, and perfecting a nationwide organization that will truly represent the profession. This is being done through state public affairs committees which are to function two ways: (1) to engage themselves in local and state problems along the general lines of the Council's purpose; and (2) to become corresponding committees on national policies, which may grow out of the consideration of state and local problems.

State and local societies are showing a renewed interest in the Council, and some 15 new societies have joined, or are in the process of joining, under a membership plan which provides affiliation for a reasonable fee. Their connection with the Council will strengthen the national professional organizations and also give the local groups an opportunity to participate in national questions in an organized and constructive way.

The Council functions through committees of experienced men who study legislative measures and policies which affect business, industry, and government agencies. They furnish advice and assistance to congressional committees, government agencies, and business and industrial organizations, on all questions or matters where it is evident that trained engineering minds may be of service.

Just now the federal and state programs are of first importance. But the majority of engineers are in private industry; therefore the development of technology in backward industries is considered the main field for the future growth of the profession. Other objectives include the raising of the prestige and purposes of engineers in the public mind through a program of public education, and the clarification of engineering-economic purposes among engineers themselves.

Our officers firmly believe that there is a great need and real opportunity for advancing the engineering profession by promoting the purposes of functional organizations and establishing coordinated committees between existing agencies, rather than starting new societies. We appreciate the wonderful cooperation that we are receiving from the organizations which support us, and I wish to express my gratification at this opportunity for the exchange of ideas with those representing other organizations serving the profession. I feel that each of our representative organizations is deriving benefit from cooperating with the others, and it is certain that the most effective cooperation may be brought about by a clear understanding on the part of each of us as to what the other is trying to do.

THE ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

By C. F. HIRSHFELD

CHAIRMAN, ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT
CHIEF, RESEARCH DEPARTMENT, DETROIT EDISON COMPANY, DETROIT, MICH.

THE ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT (E.C.P.D.) is a comparatively new agency of the engineering profession, having been brought into being in October 1932. It was formed as a result of a very general realization that (1) the time has arrived when engineering must take its place among the learned professions; and (2) the engineer must prepare himself for a greater and more extended degree of usefulness if he is to measure up to the demands that the present social structure is certainly preparing to place upon him.

The purpose of E.C.P.D. is to enhance the professional status of the engineer. It aims to coordinate and promote aspirations and efforts directed toward higher standards of education and practice, greater solidarity of the profession, and greater effectiveness in dealing with technical, social, and economic problems.

E.C.P.D. is necessarily a joint body because the purposes for which it was formed could not be achieved except through the sympathetic cooperation of national organizations representing several different interests in the profession. It consists of 21 members, three appointed from each of the following seven participating bodies: The American Society of Civil Engineers; the American Institute of Mining and Metallurgical Engineers; the American Society of Mechanical Engineers; the American Institute of Electrical Engineers; the American Institute of Chemical Engineers; the Society for the Promotion of Engineering Education; and the National Council of State Boards of Engineering Examiners. It is believed that the first five of these represent adequately the major branches of the practice of engineering. The sixth represents the educational interests. The seventh, a national organization formed by members of the boards set up by the different states for the registration of engineers, is obviously a necessary participant since it represents the increasingly important legal aspect of, and legal responsibility of, the profession. In growing numbers the states are enacting laws to give professional status to engineers meeting certain requirements with respect to education, accomplishment, and character.

E.C.P.D. is not a self-continuing nor an independently-acting organization. Since its members are appointed by the seven participating bodies, the latter always have it in their power to make its membership what they will. It functions by studying questions within the range of its objectives and by making recommendations to the governing boards of its sponsor bodies with respect to activities or procedures that it considers would be of value in enhancing the professional status of the engineer. It has no authority to undertake more than this unless specifically authorized to do so by those who formed it. Nor does it have authority to administer recommended procedures unless these have been approved by the governing boards of the participating societies and then specifically assigned to E.C.P.D. for administration.

Enhancement of the professional status of the engineer is a most intangible sort of thing. This very intangibility gives rise to many different views of the methods that might be pursued. The Council has taken the view that the soundest procedure is for the engineer so to improve himself and his capacity for service that he certainly will measure up to any demands that society may find it necessary or desirable to make upon him. It believes that the ability to serve adequately in professional capacity is bound to bring adequate professional recognition.

Such ideas make possible the preparation of a very definite program. Parts of this program already have been submitted to the governing boards of the participating societies; some of these have been approved and are now active projects.

E.C.P.D. started by appointing four subcommittees, each charged with the study of a certain field of endeavor with instructions to report back to the Council. These sub-committees are: the Committee on Student Selection and Guidance, the Committee on Engineering Schools, the Committee on Professional Training, and the Committee on Professional Recognition. With the explanation that student selection and guidance refers to the entry to colleges of engineering, it becomes obvious that these subcommittees cover the entire span from the time the boy considers seriously his entry into a college of engineering until he has reached the full stature of a professional man.

The first committee is under the chairmanship of Dean R. L. Sackett. Its function is to report to E.C.P.D. schemes for the educational and vocational orientation of young men with respect to the characteristics of an engineering education and the responsibilities and opportunities of engineers, in order that only those who have the high qualities, aptitude, and capacity required to obtain intellectual satisfaction therefrom may seek entrance to such courses.

The Committee on Engineering Schools is under the chairmanship of Dr. Karl T. Compton. Its function is to report to E.C.P.D. means for bringing about greater and more effective cooperation between the engineering profession and the engineering schools, as well as to report criteria for colleges of engineering which will ensure to their graduates sound educational foundations for the practice of engineering.

The Committee on Professional Training is under the chairmanship of Gen. R. I. Rees. Its duty is to report to E.C.P.D. plans for the further personal and professional development of young engineering graduates and young men who are entering the profession without formal scholastic training.

The last of the subcommittees is headed by Conrad N. Lauer. Its function is to report to the Council methods whereby engineers who have met suitable standards may receive corresponding professional recognition.

All the subcommittees have already made reports to E.C.P.D. which, as a result, has already made a number of definite recommendations of a constructive nature to the governing boards of the sponsor bodies. Some of these recommendations have received favorable action; others still are before one or more of the boards for consideration.

The engineer has done a marvelous technical job. He has in a comparatively short space of time converted the abstract findings of scientists to the practical use of man in an astounding profusion of technical inventions and their materialistic embodiments. He has, in fact, completely changed the tenor of human work and life. Even the man in the street appreciates a great deal of what the engineer has done for him. But the engineer has failed to take proper cognizance of the social and economic results of his works. He appears, in most cases, to have been content to devise and execute in an altruistic spirit those material improvements which now stand to his credit without giving thought to the less materialistic but equally real problems that he was bringing into being. If he gave any thought to such matters at all, he appears to have believed that others would take care of them as their share, provided he took care of his.

It now appears that we have failed to preserve a proper balance between inventions of two radically different sorts. Inventions in science and its application appear to have outstripped inventions of a social and economic nature. It also appears that we shall have to make real efforts toward the restoration of a more nearly perfect balance if the works of the engineer are not to prove of less real value to the race than he has fondly hoped.

E.C.P.D. does not have any inflated notion of the engineer's abilities outside the technical field, but it does believe that the engineer is best able to interpret his own works. And it does believe that, if properly educated in extra-technical subjects, he can be of great assistance to those normally expected to make the social and economic inventions now so sorely needed. Also, it believes that the time has arrived when the engineer must expand the field of his activities while remaining technically sound and while continuing to consider the planning and execution of engineering works as his primary job.

The program of E.C.P.D. therefore visualizes the production of an engineer of much greater breadth of vision than has been customary in the past. It stands for the soundest sort of training in technical matters but aims, at the same time, to develop that broad appreciation of human problems that it feels necessary in the engineer of the future. By such a route it sees the engineer growing to full professional status and to full recognition as a professional man.

INDUSTRIAL PROSPECTING

By C. F. Kettering

Chairman, Division of Engineering and
Industrial Research, National Research Council
Vice-President, General Motors Corporation and President, General
Motors Research Corporation

We have been told by a great many intelligent people that it is the mechanization of the country that has caused its difficulties. We are supposed to have advanced scientifically very much faster than we have socially or economically. I do not believe this at all. I think that we are fifteen or twenty years behind our social and economic development in our scientific development. We need more research.

I often say that research is a way of finding out what you are going to do when you can't keep on doing what you are doing now. If there had been more research with this viewpoint in mind, we would not have been in our present difficulties. All that this definition means is that what we are trying to do is to develop new industries which will provide more jobs. Since there are more men than jobs at the present time, it looks as though there were plenty of work left for industrial research.

Research is industrial prospecting. The oil prospectors use every scientific means to find new paying wells, and oil is found by each one of a number of methods. My own group of men are prospecting in a different field in which they use every possible scientific means. We believe that there are still things left to be discovered. Some day we will strike a gusher that will keep us industrially busy for a long time to come, refining the new oil of knowledge and making it into useful new products. Men will go back to work, and all of us will live fuller, more useful lives as a result.

One of the reasons why industrial prospecting has not been more used is because we have used the wrong kind of bookkeeping. In manufacturing, detailed costs must be determined. To each individual part we charge cost of overhead, materials, processing, distribution, and advertising and then arrive at a fair selling price. But research is not manufacturing. We have nothing to sell but ideas, and they are the cheapest thing in the world.

A few weeks ago I was talking to an engineer in the oil business. He said, "Once most of my time was taken up trying to allocate the costs of prospecting to each different method we use and to each separate paying well it brought in. I soon found I didn't have any time left to do any actual work. I'd turned into a bookkeeper. So, I turned around exactly 180 degrees. Instead of trying to make each separate activity pay its own way, I simply look at the total results of all our work. It is so obvious that the prospecting department pays for itself as a whole, that there is no question of its value. Now, I sleep easily and am back on constructive work."

Industrial prospecting should be treated the same way. You can't expect each individual project to show a profit at the end of a set time. Suppose the results of some line of study are negative. It might save a lot of otherwise wasted money to know that a thing won't work. But how can you accurately evaluate negative results? If we average all the developments of a research laboratory over a period of years, it will be "in the black." A large number of projects must be considered over a long period of time. Then, if the results are good, the project is worth continuing.

Industry has been criticized for having several times too large a manufacturing capacity. We will never have too large a capacity until everyone has the things he needs and wants. We really should say we have too few products for our factories to make. Just after the War we were so busy building factories to supply the products demanded by the public that we forgot that some day we would catch up with the demand. We should have been spending time developing new products for the future.

I believe that we are getting back to a saner view of industry. New products are being developed, and minds are at work planning for the future. The world isn't finished. We have only begun to make it a better place for man to live in. In the past four or five years there has been an intellectual depression as well as an economic one. Whenever things do not go exactly right, we always have a number of reasons why. Some of the people who try to give those reasons may never have thought of the problem ten minutes before. Consequently, there are foolish suggestions as to how to overcome the difficulty.

Today we must recognize the fact that we are in a difficult economic situation. I want to congratulate all those who have participated in working out of the emergency situation. But we must realize that we must make up our minds whether we are going to continue to live in an emergency situation or whether we are going to go some place. We have some place to go with all the unknown things around us.

We are witnessing great changes in every walk of life. In many things our ideas are exactly the opposite of those we held a few years ago. In medicine, a few years ago, the doctors used to regard fever as being extremely dangerous. Today fever can cure, instead of kill, if it is properly applied. In many lines we are questioning the things we thought we knew for sure and finding that they were only definitions handed down to us by an older generation With changed conditions, they no longer hold.

Let me illustrate this point more fully. In the last year there has been a great revival of interest in the railroads because of the development of streamlined trains. The power plant in these trains is a Diesel engine of a type which was tried out many years ago and found to be a failure. The reason it was a failure was because 20 or 30 years ago we didn't know how to build it. The principle upon which it operated was sound. The things that have been learned in metallurgy alone in the past 25 years would account for 50 such failures, to say nothing of the advancement in the accuracy with which parts can be manufactured.

When the Diesel engine was given another chance in the light of all the new information available it was an immediate success. One of the fundamental parts of this engine is fit to an accuracy of a quarter of a tenth of a thousandth of an inch—not because we want to make it that way, but because oil under high pressure will leak through any greater clearance and the engine won't work. With the present materials and methods of manufacture, it is possible to build parts with this accuracy which will operate for a long period of time. If we had taken the results of past experience without questioning the reason for the first failure, we would never have had the present light-weight, high-speed Diesel engine which appears to be the vitalized spark needed to stimulate the railroad business.

Today, as never before, we need new things. We have in no manner exhausted even a small percentage of the ability to make improvements, further developments, or increase the utility of a product. We cannot, however, do this unless we make it one of the fundamentals of our profession. We are not only in a depression, we are in a stagnation as well. When we once realize that the way out of stagnation is motion or activity, we will be started on the way out of our difficulties.

We know that time goes on whether we like it or not. Every 24 hours the earth turns once, and every year it goes around the sun. As surely as the earth turns, tomorrow and next year we are going to demand differences. The calendar is our hardest taskmaster. Its demands in change must be recognized if our present system is to survive. Since we let the calendar get ahead of us in the past few years, we must work doubly hard to catch up.

Officers Visit Society Groups

AT ITS MEETING last January the Board of Direction made provision for facilitating contacts by Society officers with various local groups, particularly those within their own districts or zones. As a result, many such visits have since been made. At the Los Angeles meeting of the Board the following contacts were reported:

President Tuttle
- May 3, 1935—Spring Meeting of the Conference of Metropolitan Student Chapters at New York, N.Y.

Vice-President Riggs
- May 11, 1935—Toledo Section at Toledo, Ohio
- May 14, 1935—Joint Meeting at Lansing, Mich. (Detroit Section: Lansing members; and Michigan State College Student Chapter)
- June 22, 1935—Colorado Section at Denver

Director Barbour
- April 25, 1935—Dinner of Connecticut Section at New Haven, Conn.
- May 16, 1935—Dinner of Massachusetts Institute of Technology Student Chapter at Boston, Mass.

Director Crawford
- February 8, 1935—Spokane Section at Spokane, Wash.
- February 21, 1935—State College of Washington Student Chapter, at Pullman, Wash.
- April 29, 1935—University of Washington Student Chapter at Seattle, Wash.
- April 29, 1935—Seattle Section, at Seattle, Wash. (Evening)

Director Horner
- May 24–25, 1935—Mid-South Section meeting at Little Rock, Ark.

Director McDonald
- April 25–26, 1935—North Carolina Section at Durham, N.C.

Director Morse
- May 7, 1935—Cincinnati Section, Cincinnati, Ohio
- May 7, 1935—Univ. of Cincinnati Student Chapter, Cincinnati, Ohio.
- May 15, 1935—Indiana Section at Indianapolis

Director Noyes
- April 1935—Agricultural and Mechanical College of Texas Student Chapter, College Station, Tex.
- May 2, 3, and 4, 1935—Texas Section, Annual Meeting, Corsicana, Tex.

Vice-President Sawyer
- May 3, 1935—George Washington University Student Chapter, Washington, D.C.

Director Stabler
- May 3, 1935—George Washington University Student Chapter, Washington, D.C.

Secretary Seabury
- May 9, 1935—Sixteenth Annual Industrial Conference, Pennsylvania State College, State College, Pa.

Assistant to the Secretary, Richmond
- May 3, 1935—Spring Meeting of the Conference of Metropolitan Student Chapters at New York, N.Y.
- May 20, 1935—Manhattan College Student Chapter at New York, N.Y.
- May 22, 1935—Cooper Union Student Chapter at New York, N.Y.
- June 14, 1935—American Engineering Council
  - Bureau of Labor Statistics consulting on analysis of survey
- June 24–27, 1935—Society for the Promotion of Engineering Education, at Atlanta, Ga.

Field Secretary Jessup
- April 5, 1935—University of Florida Student Chapter at Gainesville, Fla.
- April 8–12, 1935—District of Columbia Section, Washington, D.C.
- April 11, 1935—George Washington Univ. Student Chapter at Washington, D.C.
- April 11, 1935—Catholic Univ. of America at Washington, D.C.
- April 17, 1935—Student Chapter Joint Meeting at Swarthmore College, Swarthmore, Pa.
- May 6–7, 1935—A.W.W.A. Convention at Cincinnati, Ohio
- May 11, 1935—Toledo Section at Toledo, Ohio
- May 13, 1935—University of Mich. Student Chapter at Ann Arbor, Mich.
- May 13, 1935—Ann Arbor members
- May 14, 1935—Joint Meeting at Lansing, Mich., of Detroit Section, Lansing members, Michigan State College Student Chapter, and University of Michigan Student Chapter
- May 16, 1935—Central Illinois Section at Urbana, Ill.
- May 16, 1935—University of Illinois Student Chapter at Urbana, Ill.
- May 17, 1935—Illinois Section at Chicago, Ill.
- May 27, 1935—New Haven, Conn. (with officers of Connecticut Section)
- May 28–29, 1935—Boston, Mass. (with Society officers and others)
- June 4–5, 1935—Syracuse, N.Y.—New York State Association of City and Village Engineers and Mayors and City Officials Conference; also with officers of Syracuse Section

Other visits during the same period, particularly on the part of those from Headquarters, have previously been noted in the April, May, and July issues. Where the scheduled itinerary had to be adjusted, necessitating changes in the previous announcements, the visits are repeated in the foregoing list, with corrected details. Thus 17 additional visits by Field Secretary Jessup have already been noted and so are omitted here. As this issue goes to press he is making a series of contacts with Local Sections in Pacific Coast states, stopping on his return journey to visit Sections in the Middle West. He is not scheduled to return to Headquarters much before the middle of August.

Local Sections Conferences

LOCAL SECTIONS CONFERENCES, initiated some 10 or 11 years ago, but given up when the depression caused the number of meetings held each year to be curtailed, are to be reinstituted at the Birmingham meeting.

The theory of holding spring, summer, and fall meetings around the country, carrying the Society to the membership, as it has been said, is that the country be divided into three regions, each of which will be visited in turn. Birmingham lies in the Southern region and at the Local Sections Conference to be held there representatives will be expected from the following 14 Local Sections: Alabama, District of Columbia, Florida, Georgia, Louisiana, Maryland, Miami, Mid-South, North Carolina, Oklahoma, South Carolina, Tennessee Valley, Texas, and Virginia. Provision is to be made for paying part of the expenses of the representatives, mileage to be on the basis of 5 cents per mile one way. The rules governing these conferences require that each representative shall be a member of the Board of Direction of the Local Section, that is, some person of wide experience in Local Section matters, one who is in a position to speak with a high degree of authority on behalf of the Section which he represents.

The agenda, issued in advance of the conference, present the opportunity to discuss both problems and experiences of the Section and Society affairs. Opportunity is afforded, too, for the chairmen or contact members of committees to explain the work assigned to them.

American Engineering Council

The Washington Embassy for Engineers, the National Representative of More Than 200 National, State, and Local Engineering Societies Located in 40 States

CONSTRUCTION AND THE GOVERNMENT

THE CLASH BETWEEN principle and method continues to make each day a lively one in Washington. The situation with regard to the allotment of funds for engineering projects under the Works Relief Administration, noted in the July issue, has not changed. The general trend is toward small work-relief projects. Many of the large state projects are being broken up into small projects. Each state is a unit by itself in relation to the procurement of funds, and some progress is being made by those states which are aggressively organized to secure funds.

The NRA seems practically defunct, at least in terms of its original purpose as a sort of super-management organization for industry. Those trade practice relations that have grown up under codes that relate to prices and competitive trade practices are being gradually transferred to the Federal Trade Commission. The parts of the codes having to do with labor are to be operated under the special bills, notably the Wagner Bill and the Guffey Bill. The only part of the NRA setup which is functioning as originally intended is the Research and Statistical Division, which of course has become a sort of centralized agency for the collection of general business information.

What might be termed the mass-educational program for business men, which has been conducted by trade associations and by code authorities on the improvement of business practice, is being continued under so-called voluntary agreements in which many of the trade associations have taken the initiative. In New York, for example, a council on trade agreements has been developed by the Trade Association Executives' Organization of New York in cooperation with the American Arbitration Association.

Under the plan of insuring loans for industrial rehabilitation, the possibilities of plant modernization are being pushed by the Federal Housing Administration. Our understanding is that there are many applications involving engineering improvements in machinery and equipment. The Federal Housing Administration does not supply the money for these, but insures loans from other sources. This development is of considerable engineering significance in so far as it improves the possibilities of credit for loans for capital goods.

CHANGES IN PWA RULES

The following changes in PWA policy are included for the benefit of engineers who may be affected by or participate in the Works Relief Program. All of these are important concessions likely to be of much assistance to the entire engineering profession.

The Public Works Administration will now make advance payments of not more than 15 per cent of approved projects to enable the applicant to pay for architectural, engineering, planning and legal fees, cost of surveys, and other preliminary steps toward the launching of actual construction. It is no longer necessary for engineers and others furnishing professional services to wait for actual construction to begin before they can be paid for such services.

The responsibility for fixing wage rates on PWA projects has been placed on the borrower and recipient of the grant made in connection with loans. This policy makes it easier to adjust wage rates to fit actual conditions in each community.

The regulation requiring 90 per cent of workers on each project to come from relief rolls is retained; but it is now stated that exceptions may be made on individual projects with the approval of Harry L. Hopkins. This makes it possible to complete projects handicapped by the rigid 90 per cent rule. It will be necessary however, to show actual cause for such exceptions to Mr. Hopkins or his Public Works Administrators in the states.

EMPLOYMENT NOTES

It is expected that comparatively few positions will develop in Washington, but much activity is expected in the states under the direction of state administrators of the Works Progress Administration. State organizations are being formed now, and engineers seeking employment should be advised to contact the state administrators and chief engineers of the Works Progress Administration.

Engineers of advanced age and those partially incapacitated may find it possible to help with the direction of the delinquent income-tax-payment investigation. Engineers serving as permanent or temporary public officials should be encouraged to use their "good offices" to have all engineers of those qualifications who are on relief rolls employed in connection with the execution of that investigation.

Instructions to the state administrators tell them not to engage in or make use of politics in connection with the execution of the Works Relief Program, but appointments and assignments indicate that political sponsorship in the state may be as necessary as similar approval in Washington.

Engineers serving in administrative, consulting, professional, and supervisory capacities will be paid salaries and fees slightly less than those prevailing in the area where they are employed. Engineers on relief rolls must work for a maximum of $94 per month until they reach the place where they can "strike out for themselves." The newly created National Youth Administration will provide part-time employment for young people between the ages of 16 and 25, inclusive, from "relief families." It will pay high school students $6 per month, college students $15 per month, and those doing graduate work proportionately. Each individual case must be a member of a "relief family." Consequently this is not a program for unemployed young people from "non-relief families."

OTHER NEWS ITEMS

The cooperative survey of the engineering profession was an assured success when the final dead-line for receipt of questionnaires fell on July 8. As this is written, it is impossible to arrive at the exact number of blanks received. Some will have to be weeded out because they come from men not properly qualified as engineers. But the number is ample to provide a good cross section of the engineering fraternity and to chart its situation through the depression years. As soon as the pressure of urgent federal work permits, the Bureau of Labor Statistics will tabulate the results so that complete data will be available for planning the future course of the profession. Plans for the final tabulation were reported in the July number of CIVIL ENGINEERING.

Variable soil conditions in New Orleans have led to difficult foundation problems and a study of existing foundations, now under way there as a white-collar project under the FERA, is expected to be of great value in planning future construction. This project is sponsored by the Louisiana Engineering Society. The work is employing 25 engineers, architects, and draftsmen with additional clerical help. Engineering societies wishing to have similar work done in their areas may consult local relief and works progress officials. The Council's office will appreciate descriptions of good projects which ought to be suggested for promotion by engineering societies in other regions.

The Council's inquiries as to the participation of engineering societies in public affairs have produced many interesting letters and suggestions which are helping in the compilation of a record of experience in this important field. Various explanations are offered as to the reason why engineers, having made an inestimable contribution to the general welfare in their technical work as individuals or as a profession, do not appear more in the general field of public affairs. The system of Public Affairs Committees, which the Council is developing, together with the more aggressive action of engineering societies throughout the country, may tend to establish natural channels whereby engineers will be drawn into public matters with the aid of their colleagues, and will not have to fight their way as individuals without help, encouragement, or objectives other than their own.

"The Formation of Capital," a new study by the Brookings Institute, completes the trilogy begun in "America's Capacity to Produce" and "America's Capacity to Consume," the findings of which are correlated and given added significance when viewed in their relation to the capital structure. As with the earlier reports, this study has been summarized in a pamphlet by the Maurice and Laura Falk Foundation of Pittsburgh. The Council has a limited supply for distribution to engineers interested in new concepts of the national economy.

J. F. Coleman, president of the Council, has been invited to serve as a member of the Construction and Civic Development Department Committee of the U. S. Chamber of Commerce during the next twelve months. A. P. Greensfelder, president of the Fruin-Colnon Contracting Company of St. Louis, Mo., is chairman of the committee. It is a small advisory group to aid the Commerce Department in forming policies regarding public works.

Washington, D.C.
July 19, 1935

1935 Freeman Scholarship Awarded to Paul W. Thompson

THE Society's Committee on Freeman Fund has awarded its 1935 Freeman traveling scholarship in hydraulics to Paul W. Thompson, Jun. Am. Soc. C.E., Corps of Engineers, U. S. Army. Selection was made from a large field candidates.

The Freeman scholarships, financed from a fund established in 1924 by the late John R. Freeman, Past-President and Honorary Member Am. Soc. C.E., provide a year's study of experimental hydraulics in the laboratories and universities of Europe.

Lieutenant Thompson is well qualified, both by practical experience and formal schooling, for the award. After being graduated from West Point in 1929, he was assigned to the Kansas City Engineer District, where he observed construction work on the Missouri River navigation project and assisted in the preparation of the "308" reports on tributaries of the Missouri River. After a short detail at Ft. Logan he was sent to the University of Iowa for postgraduate work, and in 1932 he became assistant to the director of the U. S. Waterways Experiment Station at Vicksburg, Miss.

During his tour of duty at Vicksburg, Lieutenant Thompson supervised the construction and operation of a great variety of hydraulic models, including river models with fixed beds and with movable beds and harbor models designed to produce tide and wave effects. He also conducted a series of flume tests on sand movement. In the spring of 1933 Tulane University conferred upon him the degree of civil engineer.

In October of 1933 Lieutenant Thompson was assigned to the Omaha Engineer District, where he is still engaged in general river work. During 1934 he was temporarily transferred to the Kansas City District to design, construct, and operate a large model of the proposed spillway for the Fort Peck Dam. He expects to leave for Europe early in the fall.

In previous years these scholarships have been awarded as follows: In 1927, to Lorenz G. Straub, F. Theodore Mavis, and Morrough P. O'Brien, Associate Members Am. Soc. C.E.; in 1928, to Clarence E. Bardsley, M. Am. Soc. C.E.; in 1929, to James G. Woodburn, Assoc. M. Am. Soc. C.E.; in 1930 and 1931, to Hans Kramer, M. Am. Soc. C.E.; and in 1932, to Herbert H. Wheaton, Assoc. M. Am. Soc. C.E., and Donald P. Barnes, Jun. Am. Soc. C.E.

The Society as an Information Bureau

"WE ARE MEMBERS of the student chapter at .... University, and are invited to put on a stunt for a meeting of the Local Section. Can you suggest one?"

"I am engaged in relocating lost corners of valuable property.... Kindly send me a bibliography on trees—their habits of growth and means of identification."

"How thick must concrete be laid ... to prevent water beneath it from freezing?"

"I am coming to New York soon on vacation. What is there to see?"

Not a scene from *Beggar on Horseback*—just random excerpts from Society mail. More than 1,000 inquiries come by letter each year, and fully as many more are made by phone or in person. They indicate, in their wide variety, the interest of the engineer in almost every branch of human endeavor.

It is not only engineers, however, who utilize this source of information, but men of other professions, business men, students, laborers, and farmers as well. Regardless of the status of the inquirer, the Society gives either an answer or definite instructions as to where one can be found. Frequently, from members in foreign countries, the request is for books not locally available; then the Society acts as purchasing agent, without charge.

The work of handling inquiries at Society Headquarters is not delegated exclusively to any one person or group, but devolves upon various individuals in accordance with the nature of the question. Highly technical inquiries may be brought to the editor of PROCEEDINGS or of CIVIL ENGINEERING, or may go to the staff of the Engineering Societies Library. This latter step is usually taken where the answer requires technical material not available in Society publications. If a satisfactory answer can be given in the space of a half-hour or so, no charge is made by the library for this service; if longer research is necessary, the inquirer is at once notified and asked to set a permissible limit on cost. Library work is charged for at $2 an hour. Most research questions can be answered more quickly if addressed directly to the Engineering Societies Library than if sent first to Society Headquarters. There is no difference in charges.

Persons seeking information should frame their questions explicitly, in order to eliminate unnecessary work on the part of the staff and delays caused by additional correspondence. Fortunately the man who recently asked what the library had "on railroads" was present in person and able to limit the question later to streamlined trains. Even a question that seems to its framer to permit of only a narrow interpretation may appear broad and easily divisible to one not acquainted with the particular problem on which it was based. This tendency to vagueness is in part due to the engineer's familiarity with his own work; it is probably also, in some cases, due to his reticence in disclosing important information. Such hesitance, however, is unwarranted. The position of the Society is one of trust, and any inquirer can safely divulge to it whatever information is essential to an intelligent answer.

In all its replies the Society tries to be helpful and courteous, but it does not attempt to become either the dictator of "best" practice or the arbiter of disputes. It serves rather as the unprejudiced trustee of the researches and technical papers of civil engineers, and as a forum in which these researches and papers can be developed and clarified; questions on which there is any difference of opinion are answered, therefore, with excerpts or bibliographies giving impartially all views on the subject. Above all, the Society does not take upon itself any of the functions of the consulting engineer. Persons seeking free engineering advice—and there are many—are given textbook references and a list of engineers prominent in the field of their particular interest.

The subject matter of many inquiries indicates that some engineers having access to large public libraries do not realize the ease with which they can obtain certain material locally. Particularly when the information sought has been published in periodicals, an engineer doing his own research work can frequently find in an hour a considerable part of what the Society could supply only after a delay of two or three days. A description of two library aids to such preliminary research is perhaps in place here.

Engineering Index, which has appeared annually for the last 50 years, has catalogued a total of some three-quarters of a million references, of which 40,000 were published last year. Among the 2,000 publications currently listed—half of them foreign—158 are primarily devoted to one or another branch of civil engineering. The value of this index, however, lies not solely in its great scope but in its detail as well. The summary of each article in the civil engineering field is prepared by a competent civil engineer and is sufficient in detail for one to decide whether any particular reference is worthy of further consideration. Readers of CIVIL ENGINEERING are already familiar with the form of *Engineering Index*, the section in this publication entitled "Current Periodical Literature" being composed of items selected from the index's civil engineering divisions and serving to keep the index up to date throughout the year. To anyone interested in obtaining complete and up-to-date information on periodical literature concerning some specialized engineering subject, the Index offers a weekly filing-card service.

Industrial Arts Index has been published for 22 years, and is a subject index to more than 200 engineering, trade, and business periodicals, books, and pamphlets. American publications predominate, but some outstanding foreign ones are included. Only titles of articles and their publication references are given. Subheadings dividing the articles by subject matter are carefully made, and every important article is indexed under as many subject headings as the content demands. This index, appearing each month, is cumulative quarterly and annually.

It is hoped that members will continue to make increasing use of the Society and of the Engineering Societies Library as bureaus of information, and that the discussion of local aids to research will not be construed as indicating unwillingness to serve. This discussion is, in itself, one of the services of the Society's bureau.

Preview of Proceedings

After the usual interval of two summer months during which Proceedings *does not appear, the next, or August, issue, will mark the resumption of publication. This issue will contain four papers on the following wide range of interesting subjects: Flood records of the River Nile; failure theories of materials under combined stresses; the distribution of stresses under a foundation; and low-temperature characteristics of bituminous paving compositions.*

Flood-Stage Records of the River Nile

To fill a growing need for longer hydrographic records pertaining to American streams than those now available, C. S. Jarvis, M. Am. Soc. C.E., has made a comprehensive study of the long-term records of rivers in Europe, Asia, and Africa. In a paper entitled "Flood-Stage Records of the River Nile," which has been scheduled for the August issue, he deals briefly with long-term records in general, particularly as applied to rivers in Europe and Asia; but the major part of his paper, and its underlying purpose, has to do with flood-stage records of the River Nile in Egypt. He makes no special effort to evaluate the data other than to present the records in graphical form as a preliminary to further study by the profession.

A Proceedings paper in this form is designed particularly to encourage discussion. The records of the flood stages on the Nile River are clothed in a profusion of historic questions relating to their interpretation and accuracy. It is the hope of the author to sift out new concepts, new interpretations, or new proofs by which a more thorough evaluation of these historic data may be obtained from the viewpoint of the modern hydraulic engineer. The units given are in meters, cubits, and digits with corresponding values given, throughout, in English equivalents.

Marks engraved on the cliff walls in the valley of the Nile have been identified as dating back to the twelfth dynasty, 1,800 or more years before Christ. The annual flooding of the valley in the late summer settled enough moisture in the soil to ensure fair crops in the autumn and winter. Consequently, the most important annual event in Egypt was the Nile flood, and the markings of its various stages have been subjects of intense interest on the part of archaeologists, and now of engineers. It is the record of the last 1,300 years that forms the basis of Mr. Jarvis' paper, a careful compilation, study, and appraisal of all available records on this subject to date.

Failure Theories of Materials Subjected to Combined Stresses

Several theories have been devised and tests made to determine the laws of failure of materials subjected to combined stresses. In a paper for the August Proceedings entitled "Failure Theories of Materials Subjected to Combined Stresses," Joseph Marin, Jun. Am. Soc. C.E., extends the correlation of both theories and test results so that they can be represented on a common set of coordinate axes. Without such a correlation, some test results on combined stresses have been interpreted incorrectly. Some theories have been extended from their original formulation in order to permit this correlation. In addition, new theories based on other physical concepts are presented. After the theories are correlated, it is a simple procedure to evaluate the resulting differences in design of structural and machine elements due to the use of different theories. Thus, from diagrams accompanying the paper, it is possible to determine for a particular theory, the dimensions of members subjected to a given loading. Practice varies as to what theory is used. It would be desirable to determine a specification for design in cases of combined stresses. It is with this end in view that this paper is presented.

The Distribution of Stresses Under a Foundation

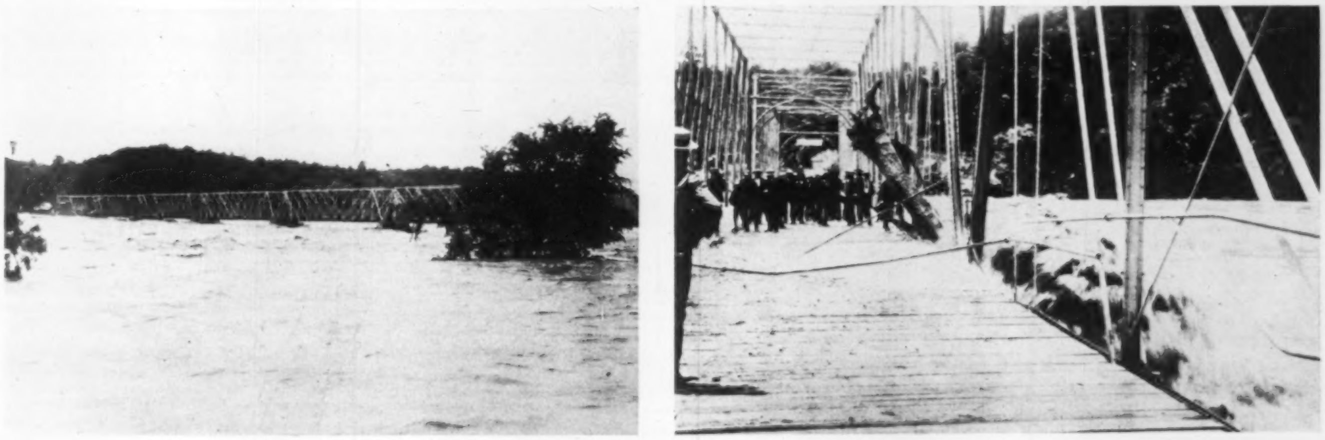
The forthcoming issue will also have a paper on "The Distribution of Stresses Under a Foundation" by A. E. Cummings, Assoc. M. Am. Soc. C.E. In this he outlines the elementary theory of the distribution of stresses due to a point load applied to the plane boundary of a semi-infinite, elastic, isotropic solid as given by Boussinesq. The theory is extended to show its application to loads that are distributed, either uniformly or parabolically, over a circular bearing area on the surface of the solid. There is also a suggested modification of the basic equations that makes it possible to apply them to soils which, in general, are not elastic, isotropic solids.

To demonstrate the accuracy of the theory, a comparison is made between it and a considerable number of experimental data that have been gathered, both in this country and in Europe, over a period of 50 years. A numerical example brings out the difference between stresses computed with the equations of the theory of elasticity and a uniform load distribution and those computed with the modified equations and a non-uniform distribution.

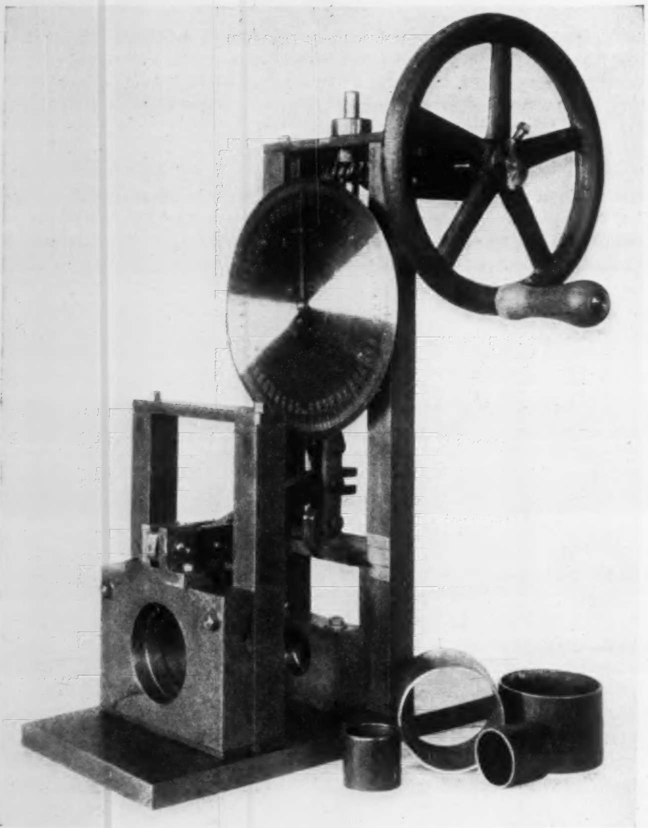
The paper is clearly and concisely written and contains valuable references and sources of information. It should be useful and interesting to engineers who have to deal with problems of foundation engineering.

Some Low-Temperature Characteristics of Bituminous Paving Compositions

Designers of bituminous paving surfaces are handicapped by a lack of information on the resistance of a mixture to cracking under low-temperature service conditions. Members of the Society interested in this subject will find much of value in a paper, also in the August Proceedings, by H. W. Skidmore, Assoc. M. Am. Soc. C.E., entitled "Some Low-Temperature Characteristics of Bituminous Paving Compositions." Mr. Skidmore, who is president of the Chicago Testing Laboratory, is one of the foremost asphalt technologists in the United States and therefore speaks with considerable authority in this field. In his present paper, he points out that a great deal has been accomplished in connection with summer-temperature characteristics of bituminous mixtures, so



Chain Bridge on the Potomac River, from the Left Bank
Photographs Taken on June 2, 1889, During the So-Called "Johnstown Flood"



TYPE OF SHEAR TESTING MACHINE IN USE IN CHICAGO TESTING LABORATORY

that the elements involved in design have become thoroughly understood. Almost no study has been made in the field of low-temperature performance of paving compositions, however, and the paper is concerned with the results of a systematic course of study begun in the Chicago Testing Laboratory in 1931. In it are presented results of tests on specimens of the 20 or more bituminous cement mixtures, and the results are plotted on graphs arranged so as to be convenient for comparison and analysis.

As a result of his studies, Mr. Skidmore concluded, among other things, that it is more important to know the inherent characteristics and proper mixture of bitumens at low temperatures than at normal and higher temperatures. There is an ideal mix with proportions such that the best results may be expected over the entire range of temperature. The author recommends that in northern climates and in regions where winter temperatures are normally quite low, a bitumen much softer than is now customary should be adopted. As a general rule, relatively rich mixtures are safer than lean ones, but the mineral filler should not be in excess of the optimum for a given binder.

Engineers' Council Offers to Accredit Engineering Schools

JOINT ORGANIZATION REPRESENTING EDUCATIONAL, TECHNICAL, AND LEGAL INTERESTS OF ENGINEERS PROVIDES FACILITIES FOR RECOGNITION OF WORTHY ENGINEERING CURRICULA

THE Engineers' Council for Professional Development (E.C.P.D.), sponsored by the leading national engineering societies, the engineering educators, and the engineering examiners, has announced the inauguration of a program for accrediting engineering schools in New England and the middle Atlantic states. The program will be offered to the other parts of the country after a trial period in these two regions. Notice is being sent to the presidents of all degree-granting engineering schools in the two areas, advising them that the E.C.P.D. stands ready to receive requests for consideration of particular engineering curricula which the schools may wish to submit.

Through the E.C.P.D. Committee on Engineering Schools, regional subcommittees have been organized to visit each institution requesting recognition for its curricula. The visits by these committees will begin early in the fall, and it is expected that the accrediting in these regions will be well under way before the first of the year. The plans and procedures will be considered in the light of the experience in carrying out the accrediting process in these regions and, with such modifications as seem desirable, the plan will then be offered to the other parts of the country.

Accrediting is necessary at the present time for a number of reasons, the most urgent of which is the fact that a majority of the states have enacted laws for the licensing of engineers, and that licensing procedure requires a list of accredited colleges whose graduates may submit evidence of their graduation in partial fulfillment of the requirements of licensing. The E.C.P.D. is undertaking this work because it is the only body that represents all of the interested groups—the engineering schools, the state licensing boards, and the national engineering societies.

While the primary purpose of the E.C.P.D. through its Committee on Engineering Schools is to identify those institutions which offer professional curricula in engineering worthy of recognition as such, in longer range the purpose is to aid in promoting the best interests of engineering education and to raise the general level of its effectiveness. Emphasis will be given to quality of work, rather than to statistical information, to a greater degree than in former accrediting procedures. No hard and fast prescriptions are laid down for curricula, physical facilities, investments, expenditures, or other specific points relating to a given institution, although all of these, and others, will be taken into account in appraising the institution as a whole.

Great progress has been made in certain of the professions in raising the standards of their professional schools. The most notable of these is the medical profession. It is believed that this program of the E.C.P.D. is an important part of the broader plan for enhancing the status of the engineering profession.

In addition to the four Founder Societies, the constituent organizations of the Engineers' Council for Professional Development are the Society for the Promotion of Engineering Education, the American Institute of Chemical Engineers, and the National Council of State Boards of Engineering Examiners.

News of Local Sections

ALABAMA SECTION

There were 20 present at a meeting of the Alabama Section held in Birmingham on April 19. After a brief business session, A. C. Decker, sanitary engineer of the Tennessee Coal, Iron and Railroad Company, reported on the progress being made on the proposed engineers' license law for Alabama. A talk was given by H. H. Houk, bridge engineer in the Alabama State Highway Department, who discussed the possibilities of the federal emergency relief program, with particular reference to the opportunities of the engineer in this work. Then R. H. Woodruff, a student at the University of Alabama, presented a paper on the construction of Boulder Dam. At a meeting of the Section held on May 31, the principal speakers were E. W. Braun and W. F. Beldon, of the Linde Air Products Company, who presented several reels of motion pictures, with explanatory remarks on oxwelding in production work and on pipelines for oil and gas.

CENTRAL OHIO SECTION

A luncheon meeting of the Central Ohio Section was called to order in Columbus on May 9. The guest speaker was Walter E. Jessup, Field Secretary, who discussed current activities of the Society. There were 21 members and 5 guests present.

COLORADO SECTION

The Colorado Section reports that its officers for the coming year will be as follows: Fred C. Carstarphen, president; E. B.

Debier, vice-president; and Paul S. Bailey, secretary-treasurer. A meeting of the Section was held at the Olin Hotel in Denver on May 13, with 81 in attendance, and 58 at the dinner preceding it. Talks were given by B. B. Howe, state sanitary engineer; D. E. Kepner; and Charles A. Davis, sanitary engineer of Denver. On June 22 a meeting of the Section was held at Boulder, Colo., on the campus of the University of Colorado. During the afternoon session a small group inspected the laboratory where tests of model dams are being conducted for the U. S. Bureau of Reclamation. In the evening the party proceeded to Eldorado Springs, where 82 members and guests met for dinner. This group included a number who were en route to the Annual Convention at Los Angeles. After dinner Henry E. Riggs, vice-president of the Society, spoke briefly on the current trend toward the formation of new engineering societies.

A regular meeting of the Association of Junior Engineers of the Section was held on May 27, with 14 members present. At this session B. T. Morris, junior engineer in the U. S. Bureau of Reclamation, led a short discussion on the future of engineering. The speaker of the evening was G. Verne Mitchell, of the Conoco Travel Bureau, who outlined the work of the bureau.

Dayton Section

A meeting of the Dayton Section held on June 17, 1935, took the form of a luncheon, served at the Fairmount Golf Club through the courtesy of the Purification Systems, Inc. After luncheon the group was addressed by Charles Shook, who is connected with that organization. Mr. Shook described the methods employed by his firm in the treatment of sewage by chemical process. Following his talk, the party was conducted on an inspection trip through the firm's experimental laboratory, in which a model plant was in operation. There were 14 members and 11 guests present.

Duluth Section

At a luncheon meeting held on April 15, the members of the Duluth Section heard an interesting description of power hydraulic dredges, which are being used in the Duluth-Superior Harbor in government contracts for deepening the waterways to 25 ft. On May 27 the Section was entertained by the showing of a series of colored motion pictures made in Europe by Guy Diehl, chief engineer of the Oliver Iron Mining Company, during a recent vacation trip. The sixth annual golf tournament was held at the Northland Country Club on June 17.

Los Angeles Section

The June meeting of the Los Angeles Section, held at the University Club on the 12th, was the occasion for several interesting talks. The first speaker on the program was Dwight W. Stephenson, attorney for the PWA, who discussed the relationship of the PWA to public engineering works. He was followed by Dr. Seth B. Nicholson, of the Mt. Wilson Observatory, who gave an illustrated lecture on sun-spots and their relation to terrestrial phenomena. Then James E. Phillips, engineer on the Los Angeles-Owens River Aqueduct, described the snow surveys conducted by the Los Angeles Bureau of Water Works and Supply. A motion picture of one of the snow survey expeditions into the Sierra Nevada Mountains was shown by James E. Jones, hydrographic engineer for the Los Angeles Bureau of Water Works and Supply. According to Mr. Jones, the data obtained from such surveys enable the hydrographic division of the bureau to forecast the season's run-off within 10 per cent of the correct amount.

Louisiana Section

There were 52 members and guests present at the annual meeting of the Louisiana Section held in New Orleans on May 29. After considerable discussion of business matters, an illustrated talk was given by Harley B. Ferguson, president of the Mississippi River Commission. General Ferguson described the treatment of cut-offs on, and bank erosion of, the Lower Mississippi. The election of officers for the coming year, which was held at this time, was reported in the July issue of Civil Engineering.

Milwaukee Section

On May 23 the members of the Milwaukee Section held a meeting at the City Club. At this session, which was attended by 20 members and guests, various business matters were discussed. A report of the legislative committee on the present status of the engineers' registration law was heard, and several letters were read. Then the speaker of the evening, S. M. Siesel, was introduced. Mr. Siesel, who is president and general manager of the S. M. Siesel Company of Milwaukee, gave an illustrated address on the Robert E. Lee Bridge across the James River at Richmond, Va., for which he was contractor during construction. In describing the project Mr. Siesel referred to the plans for the bridge.

Philadelphia Section

On June 19 the annual meeting of the Philadelphia Section was held, with 71 present and 30 at the dinner preceding it. The first speaker on the technical program was Walter Samans, chief engineer of the Atlantic Refining Company, who gave an illustrated talk on "Civil Engineering in the Oil Industry," emphasizing particularly the subject of the design of the various steel structures used by the oil industry. Another illustrated paper was then presented by J. Bennett Hill, of the Sun Oil Company, who discussed the topic, "Modern Characteristics of Gasoline and Lubricating Oil." This subject was of interest to all automobile owners and drivers. Following the addresses, there was a business meeting at which the following officers were elected for 1935–1936: Charles S. Shaughnessy, president; William H. Chorlton, vice-president; and Charles A. Howland, secretary-treasurer. Talks were then given by Messrs. Shaughnessy, Chorlton, and Howland, and by P. H. Carlin.

Providence Section

The election of new officers for the Providence Section, held at the time of the annual dinner meeting on May 22, resulted as follows: Warren G. Baxter, chairman; William R. Benford, vice-president; and Frederick H. Paulson, secretary-treasurer. The secretary read a short paper that had been prepared by Mr. Feiker, of the American Engineering Council, entitled "What the American Engineering Council Is Doing for the Professional Engineer." Then Henry N. Francis, fourth oldest member of the Society, gave an interesting talk on engineering problems in Providence fifty years ago. This was followed by an address on the subject, "The Engineer as an Expert Witness," given by William H. Kenerson, chairman of the Division of Engineering at Brown University.

Sacramento Section

Weekly luncheon meetings have recently been enjoyed by the members of the Sacramento Section. These sessions have been well attended, and numerous interesting speakers have been heard. Among them were Edgar A. Brown, staff engineer of the California Redwood Association; Walter F. Dexter, executive secretary to Governor Merriam; Homer M. Hadley, regional structural engineer of the Portland Cement Association; Anthony J. Kennedy, attorney for the Structural Engineers' Association; and C. R. Stephens, assistant Pacific sales manager of the Wickwire Spencer Steel Company, of San Francisco, Calif.

San Diego Section

The June meeting of the San Diego Section was of special significance because it was the first joint meeting of the Section and the Engineers' Club of San Diego. This is an event that we hope will be repeated, as the large attendance (over 80 per cent of the full membership) indicated that local engineers were greatly in favor of it. The speaker for the evening was Charles E. Andrew, bridge engineer in the California State Department of Public Works, and his talk on the San Francisco–Oakland Bay Bridge will long be remembered.

Sunday, July 7, was designated "American Society of Civil Engineers Day" at the San Diego Exposition. The members of the Section acted as hosts, and about 65 members of the Society attended the exposition at the close of the Annual Convention in Los Angeles. There was no special program, but the visiting engineers were registered and given information concerning the exposition. In the afternoon an informal reception was given by the wives of local members in honor of the visiting ladies.

San Francisco Section

The 181st meeting of the San Francisco Section was held at the Engineers' Club on June 18, with 100 members and guests present and 82 at the dinner preceding it. Several committee reports were heard at this session, and various business matters were discussed. The feature of the technical program was a talk by Harry E. Reddick, regional (California) director of the Soil Conservation Service of the U. S. Department of Agriculture.

ITEMS OF INTEREST

Engineering Events in Brief

Civil Engineering for September

THOSE WHO attended the Los Angeles Convention are firm in their conviction that it set a high standard of technical meetings. The program was unusually well rounded and of superior quality. It will be brought to the attention of every member in as complete and attractive form as Society facilities permit, through the medium of the next issue of Civil Engineering.

A wide variety of subjects in the fields of sanitation, waterways, irrigation, highways, city planning, power, and engineering construction will be stressed. In addition, technical features of engineering work in southern California will receive a share of attention.

To present even this limited picture of the Convention it will be necessary to expand the size of Civil Engineering considerably for this issue. Papers in the September number will thus comprise the abstracted engineering reports of the Sixty-Fifth Annual Convention. The result, it is hoped, will convey in some degree the inspiration gained by engineers who enjoyed the technical sessions at Los Angeles on July 3 and 4.

Gift of "Say, One and a Half Million Dollars"

RENOWNED FOR HIS extensive benefactions, particularly of libraries, Andrew Carnegie probably never contributed to a more useful service than in his gift for the Engineering Societies Building. This month's Page of Special Interest shows the plaque in the lower lobby of the building at 33 West 39th Street, New York City, and illustrates the concise, almost laconic manner in which the bequest was made. The scene may well be imagined as the letter was being written by a canny Scotsman who had learned to dispose of his bounty for worth while causes in terms of an offhand "Say, one and a half million dollars."

Indeed the phrasing sounds so natural as almost to belie the efforts of the many men who had prepared the ground. Great as was the bounty and freely as it was bestowed, it was not brought to fruition without good reason, for Carnegie was noted as much for the usefulness of his gifts as for their generous size.

At the time the Society was not in a position to go along with the other three Founder Societies in this project; it had a fine building of its own, with attendant sentiments and obligations which could not be gainsaid. And so it devolved on others to make the preparations and secure outside support. The fascinating story of these developments has been told before but it will bear repetition. A good account appeared in the March 1935 issue of our contemporary society journal, *Mining and Metallurgy*, from part of which the following is quoted:

"It may not be known just how the societies first obtained the property. Chief credit by common consent goes to the late Calvin W. Rice, for 28 years prior to his death in October 1934, secretary of the American Society of Mechanical Engineers. In 1902 the Latimer Clark Library had been given to the American Institute of Electrical Engineers with the proviso that it be housed in a suitable fireproof building. As chairman of the A.I.E.E. Building Committee, Dr. Rice arranged a dinner of the committee to discuss plans for a modest building to cost less than $250,000. Charles F. Scott, then president of the A.I.E.E., and representatives from the other Founder Societies were invited to attend this dinner. In the course of his remarks Professor Scott, at the instigation of Dr. Rice, suggested the possible construction of a more ambitious building, one large enough to house the four societies, with a library and auditorium for the common use of all. Doubts were expressed as to whether it would be possible to bring the four societies into such a cooperative project but Dr. Rice would not let the idea grow cold.

"At the next annual dinner of the A.I.E.E. it was the subject of the president's address. Through the efforts of Dr. Rice, Andrew Carnegie was prevailed upon to attend the dinner as a guest. The next morning Dr. Rice received a note from Mr. Carnegie asking him to call at the Carnegie home that afternoon at five o'clock. Dr. Rice, with characteristic thoughtfulness, took Professor Scott with him. Mr. Carnegie asked Dr. Rice many questions about the Engineering Societies, their management, their finances, their relations to each other. Dr. Rice felt that Mr. Carnegie was considering a donation, but with keen insight he sensed that some feature was not altogether satisfactory to him. Recalling that it was Mr. Carnegie's habit to stipulate that the land on which he had built library buildings be provided by others, Dr. Rice optimistically ventured to say that the Engineering Societies would be able to finance the purchase of a site. Mr. Carnegie smiled cheerfully and said: 'If you can provide the land I will put up the building.'

"Developing the plans, effecting the organization, bringing the societies into a satisfactory cooperative agreement, and raising the money for the purchase of the site was no small task, but it was accomplished. Mr. Carnegie provided $1,050,000 for the erection of the building. Aside from Mr. Carnegie himself, the engineering profession as a whole is indebted to no one so much as to Calvin W. Rice for its headquarters in New York City."

So it came about that the Engineering Societies Building became a reality. The Society's subsequent interest in the property and its assumption of equal responsibilities and equal ownership with the other Founder Societies, is recounted in President Tuttle's address at the Annual Convention, abstracted elsewhere in this issue. It is only fair to add that Mr. Carnegie's ideal of establishing a monumental engineering library by the amalgamation of the separate libraries of the various societies has been more than fulfilled.

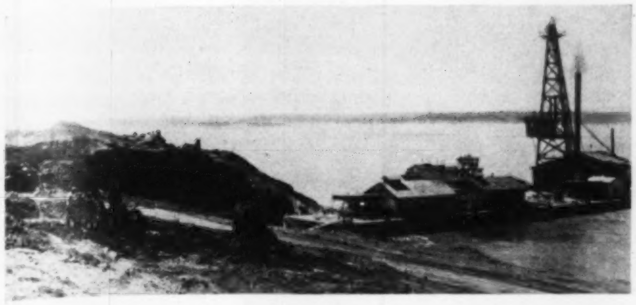
Highway Visibility Tests Made in Accident Survey

HOW FAR AHEAD can a driver see a pedestrian at night? What factors increase this visibility distance?

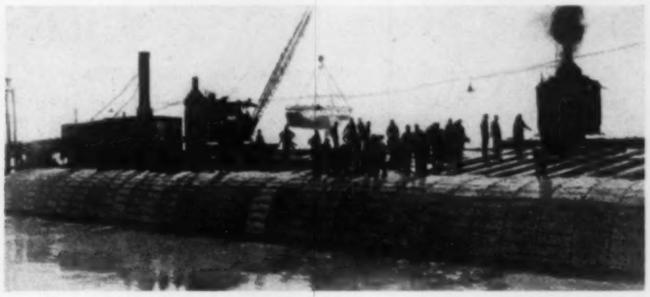
To answer these questions, more than 5,000 tests were made in 1934 as a part of the Massachusetts Highway Accident Survey, and reported in "Night Visibility Tests on Highways" by Parry Moon and R. C. Warring, in ***Public Works*** for April 1935, page 16. It was found that the type of pavement surface has relatively small effect on visibility distance, the value for concrete being 304 ft, for rough macadam 295 ft, and for smooth macadam 288 ft. On the other hand, a small area of white—say an unfolded handkerchief—increases the visibility distance about 50 per cent, and light-colored clothing doubles it.

At speeds above 40 miles per hour, a driver cannot see a pedestrian in dark clothes in time to stop before reaching him. But if the pedestrian is equipped with reflector buttons, a driver going 60 miles per hour can see him in time to stop. In the case of glare from passing cars, these speeds are reduced to 30 and 50 miles per hour, respectively, and even these speeds are made unsafe by unfavorable weather, poor brakes, dirty windshields, subnormal eyes, or inattentive driving. When 32-cp bulbs were replaced with 21-cp bulbs, the visibility distance was decreased about 14 per cent and was about the same for all surfaces.

In regard to highway lighting, the tests indicate that, with the present type of incandescent street lights and with the pedestrian in an unfavorable position between lamps, no gain in visibility distance is to be expected unless the average luminosity of the pavement is of the order of 0.05 lumens per square foot or better. With lower values, glare from the street lamps appears to offset the advantages of increased illumination. With pavement luminosity of 0.1 lumen per square foot or more, however, the visibility distance is greatly improved.



12-Yd Bank Grader at Work: Head-tower Is Mounted on Barge; Tail-Tower Travels Along the Bank



Sinking Subaqueous Revetment: Concrete Mat Being Lowered from Mat Boat to Bed of Channel

Channel Work in Progress at Leland Neck Cut-off, Ark.

Paving Mississippi Banks with Concrete

Articulated Concrete Mats, Until Recently Used for Protection of Subaqueous Banks Only, Replace Riprap for Upper-Bank Paving in New Type Revetments

Use of articulated concrete mats for the protection of the above-water banks of the Mississippi River was inaugurated on a large scale in 1934 by the Vicksburg District of the Corps of Engineers, U. S. Army. These mats, composed of concrete blocks fastened together by the clip connections of an embedded metal fabric, have been in general use in that District since 1928 for the protection of subaqueous banks, but customarily in conjunction with an upper-bank paving of 10-in. riprap. A shortage of suitable riprap material and a study of costs brought about the adoption of the new type.

Two sections of the new type revetment, totaling 9,600 lin ft, are now completed—one at American Cut-Off, 15 miles below Greenville, Miss., and one at Leland Neck Cut-Off, across the river from Greenville. Because of the nearly right-angled turn at the entrance to Leland Neck Cut-Off, its left bank is subjected to a concentrated erosive attack which provides a severe test of protection methods.

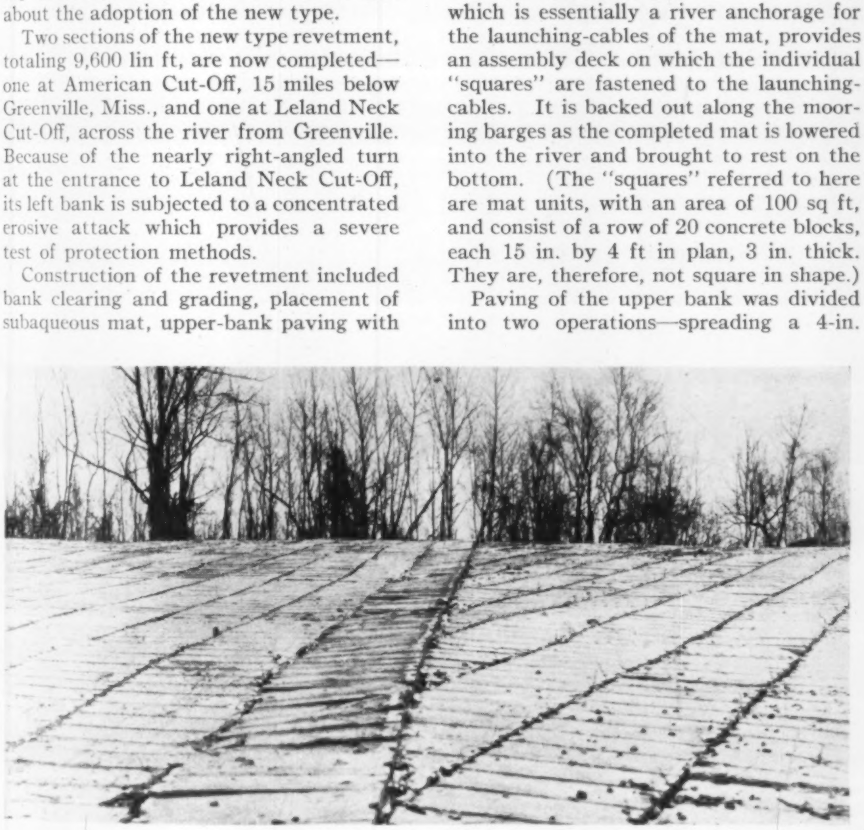
Construction of the revetment included bank clearing and grading, placement of subaqueous mat, upper-bank paving with articulated mat, and placement of tetrahedral blocks for flank protection.

After clearing, the above-water bank was graded to a 1:5 slope by a cableway bank-grader (see the accompanying illustration) with its head-tower mounted on a barge and its tail-tower traveling along the top of the bank. A dragline and tractors with bulldozers handled the finishing. The under-water mat was placed with the standard sinking-plant, which consists of a mat boat, as shown in the photograph, and upper and lower string-outs of mooring barges. The mat boat, which is essentially a river anchorage for the launching-cables of the mat, provides an assembly deck on which the individual "squares" are fastened to the launching-cables. It is backed out along the mooring barges as the completed mat is lowered into the river and brought to rest on the bottom. (The "squares" referred to here are mat units, with an area of 100 sq ft, and consist of a row of 20 concrete blocks, each 15 in. by 4 ft in plan, 3 in. thick. They are, therefore, not square in shape.)

Paving of the upper bank was divided into two operations—spreading a 4-in. blanket of gravel over the entire bank area, and placing the concrete squares on this blanket. The gravel base permits drainage for the rain run-off and percolation from the bank itself, and prevents scour at high stages through the interstices of the mat. A dragline type of bank-grading machine was used to transfer the squares from mat barges to the bank. Its traveling carriage and 155-ft boom permitted the squares to be dropped in place, except at the extreme top of the bank, where they were snaked to their final location by tractor. Once in place, the squares were fastened together with wire twisted around the projecting clips.

A strip 100 ft wide at the end of the revetment was paved with concrete tetrahedral blocks of 12-in. altitude. Those placed below water were dropped from barges; those placed in the dry were handled by a cableway type of bank-grading machine, with a rock skip replacing the grader bucket.

The work herein described was part of the regular revetment program of the Mississippi River Commission for the Lower Mississippi River. Civil Engineering is indebted to C. R. Little, Assoc. M. Soc. C.E., and to the Portland Cement Association, with which he is connected, for the information contained in this article.



View of Paving on Upper Bank

Detail of Construction at Leland Neck Cut-Off, Illustrating Method of Fitting Mat to Bend in Channel

Economics Conference for Engineers

Announcement is made of the Fifth Economic Conference for Engineers, to be held at the Stevens Engineering Camp at Johnsonburg, N.J., August 10–18, 1935. Lectures and seminars by well-known authorities are scheduled for each morning and evening, covering analysis of local, state, and federal affairs, for the particular benefit of engineers. Afternoons are devoted to recreation and sports. The complete fee is $40. Inquiries may be addressed to the Stevens Institute of Technology, Hoboken, N.J., which is sponsoring the conference.

Philadelphia–Camden High-Speed Line Nears Completion

WORK IS PROGRESSING rapidly on the Philadelphia–Camden electric high-speed line over the Delaware River bridge, a transportation project under construction with $10,681,000 of Public Works Administration funds. The subway structure in Philadelphia is practically completed. Tracks are now being laid, and the tile and other finish work will soon be installed.

The high-speed line, when completed, will provide fast, 8-min. service between Eighth and Market streets, Philadelphia, Pa., and Broadway south of Federal Street, Camden, N.J., a distance of about $2^1/_2$ miles. A bus terminal will be constructed at the Camden end. The Philadelphia part consists of two single-track tubes, each approximately 1,140 feet long, joining the Philadelphia subway system at Eighth and Race streets and extending under Franklin Square to connect with subway structures previously constructed under the north and south sides of the Delaware River bridge plaza. There will be intermediate station stops at Franklin Square, Philadelphia, and Fifth and Federal streets, Camden.

As the present Fifth Street, Philadelphia, vehicular underpass crosses under the bridge at the level to be used by the high-speed line, it was necessary to construct a new underpass at a lower level. This new structure, which will be placed in use within a short time, is approximately 1,450 feet long.

CONSTRUCTING PHILADELPHIA–CAMDEN HIGH-SPEED LINE
Erecting Forms for Sidewalls, Camden Subway Section

Survey of the World's Welding Literature

THE ENGINEERING Foundation has appointed a Welding Research Committee to (1) initiate and conduct a critical review of world welding literature, (2) to render modest aid to worthy individual projects functioning under the Fundamental Research Committee of the American Bureau of Welding, and (3) to sponsor specific research investigations. The project will be started by funds contributed by the Engineering Foundation supplemented by funds and services supplied by industry. The project is jointly sponsored by the American Institute of Electrical Engineers and the American Welding Society.

Among the first proposed activities of the committee is a canvass of industry for the purpose of determining what services can be counted upon by the committee in the formulation of a program which will most effectively utilize the total of the resources which will be available to it. These contributed services will doubtless be of various kinds: reviews of literature and translations of foreign language articles which have been or are being made for private purposes; technical assistance, materials, and the loan of apparatus in connection with specific research investigations; unpublished research data. A maximum of contribution in the form of such services can be made by industry at a minimum of additional cost.

It is also proposed to collect information from which can be prepared a list of research projects now under way and being planned that can be made available to the committee. Suggestions will be solicited for research projects which are recommended for prosecution under cooperative auspices. Another plan being considered is the setting up of a clearing house for translations and abstracts dealing with welding literature so that unnecessary duplication may be avoided and a maximum of cooperation secured in the critical abstracting of such literature.

The personnel of the committee includes C. A. Adams, M. Am. Soc. C.E., chairman; William Spraragen, secretary; J. H. Critchett; J. J. Crowe; H. M. Hobart; D. S. Jacobus, G. F. Jenks; and F. T. Llewellyn, M. Am. Soc. C.E. Communications should be addressed to William Spraragen, American Welding Society, 33 West 39th Street, New York, N.Y.

Huge Tube Proposed for Meteorological Studies

A REINFORCED-CONCRETE tube one and one-half times the height of the Empire State building and more than 400 ft in diameter at the top is proposed in France to further the study of causes of rainfall, tornadoes, and other phenomena.

Bernard J. Dubos, designer of the tube, describes its principal features in a publication of the Académie des Sciences Coloniales. Adjustable vanes with vertical axes would admit air from the outside and set up in the tube a vortex motion which, it is believed, will carry vast quantities of air up the tube and discharge it at reduced temperature and pressure at the top, thereby setting up conditions ideal for the creation of rainfall.

M. Dubos believes that studies made possible by such a tube might lead to man's developing a considerable influence over climatic conditions and even suggests that it has possibilities for aerial defense.

NEWS OF ENGINEERS

From Correspondence and Society Files

ROBERT LINTON has resigned as vice-president and general manager of Pacific Clay Products in order to devote all his time to professional work. His headquarters are in the Edison Building in Los Angeles, Calif.

JOHN MONROE JOHNSON was recently appointed Assistant Secretary of Commerce, with offices in Washington, D.C.

HOWARD W. TILLAPAUGH is now employed as a research assistant in the Iowa Engineering Experiment Station at Iowa State College, Ames, Iowa.

VICTOR LYLE STREETER has sailed for Europe following his appointment as Freeman scholar by the American Society of Mechanical Engineers. He had been employed as a junior engineer in the U. S. Bureau of Reclamation at Denver, Colo.

C. **Sumner**, civil engineer and licensed surveyor, was recently appointed city engineer of San Gabriel, Calif.

Rex P. **Johnson** recently joined the staff of the American Museum of Natural History, in New York City, in the capacity of general superintendent. Previously he was chief draftsman in the Industrial Bridge Department of the Rust Engineering Company, of Pittsburgh, Pa.

Merrill D. **Knight, Jr.**, who was formerly director of public works of Lynchburg, Va., is now employed as projects officer for the Farmville area of the Virginia Emergency Relief Administration, with headquarters in Farmville, Va.

Charles F. **Goodrich** has been promoted from the position of assistant chief engineer of the American Bridge Company to that of chief engineer, succeeding Richard **Khuen, Jr.**, who resigned after 41 years of continuous service. His address will be the Frick Building in Pittsburgh, Pa.

Ashley G. **Classen** recently severed his connection with the Western Metal Manufacturing Company of El Paso, Tex., to accept an appointment as state reclamation engineer of Texas, with offices in the State Highway Building, Austin, Tex.

A. E. **Barrekette**, formerly an engineer and contractor in Jerusalem, Palestine, is now technical director of the recently formed Palestine Road Construction Company, Ltd., with headquarters in Palestine.

John H. **Ryan** has been promoted from the position of principal assistant to the construction engineer in the Engineering Department of the City and County of San Francisco to that of construction engineer in the same department, with offices in San Francisco, Calif. His duties now place him in charge of construction on the enlargement of O'Shaughnessy Dam for the water supply of the city and county of San Francisco.

Albert **Reichmann** was recently elected vice-president of the American Bridge Company, with offices in Chicago, Ill. Previously he was assistant chief engineer of the Chicago office of the same company.

John J. **Schmitt, Jr.**, is now with Setterberg, Kadic and Schmitt, architects and engineers of Chicago, Ill.

E. T. **Jensen** has taken a position in the Bridge Department of the Iowa Highway Commission in Ames, Iowa.

Thomas H. **Evans** has accepted an assistant professorship in civil engineering at the University of Virginia in Charlottesville, Va., where he will take up his new duties on August 18. He was formerly an instructor in engineering mechanics at the Sheffield Scientific School of Yale University.

Paul **Morton** has severed his connection as city manager of Lexington, Ky., to accept an appointment in a similar capacity, in Trenton, N.J., his headquarters being the Municipal Building of that city.

Chauncey E. **Webb** has been promoted from the position of designing engineer in the Chicago office of the American Bridge Company to that of division engineer in charge of the Western Division of the same company.

A. S. **Holway** recently resigned as chief engineer of the Krenn and Dato Construction Company, of Chicago, Ill., to become president of the Holway Contruction Company, of the same city.

William G. **Fargo**, who retired some years ago as head of the Fargo Engineering Company, of Jackson, Mich., is now devoting all his time to his hobby of ornithology, being curator of the museum at the University of Michigan, in Ann Arbor, Mich.

H. W. **Pollock**, formerly an assistant engineer in the Washington State Department of Public Works, is now county engineer, Port Angeles, Wash.

John E. **Ostrander**, head of the department of mathematics at Massachusetts State College, retired on June 10 after 38 years of service. At the commencement exercises of the college he was appointed emeritus professor of mathematics.

Joseph J. **Rimsay** is now an instrumentman in the North Dakota State Highway Department, with headquarters in Forman, N.Dak.

Lyle A. **Whitsit** has severed his connection with the United Engineers and Constructors, Inc., of Philadelphia, Pa., to become principal engineer in the U. S. Engineers Office at Eastport, Me.

Guy W. **Cobb**, formerly city engineer of Jonesboro, Ark., is now district supervisor of the Arkansas State Highway Department, with headquarters in Russellville, Ark.

Emory W. **Lane**, a research engineer in the U. S. Bureau of Reclamation, has been appointed professor of hydraulic engineering at the University of Iowa, in Iowa City, the appointment to become effective on September 1.

Robert D. **Dewell** has resigned as a draftsman with the U. S. Coast and Geodetic Survey to become affiliated with H. D. Dewell and A. W. Earl, consulting civil engineers of San Francisco, Calif.

John N. **Edy**, who was formerly city manager of Dallas, Tex., is now with the U. S. Bureau of the Budget in Washington, D.C.

W. G. **Brenneke** is now resident engineer inspector in the Inspection Division of the Public Works Administration, with headquarters in Hartford, Conn.

Horatio N. **Ogden**, formerly a sanitary engineering assistant in the U. S. Public Health Service, is now a junior engineer in the U. S. Engineer Office, Second New Orleans District, with offices in St. Joseph, La.

Changes in Membership Grades

Additions, Transfers, Reinstatements, Deaths, and Resignations

From June 10 to July 9, 1935, Inclusive

Additions to Membership

Baker, Van Karl (Assoc. M. '35), 218 Garland Pl., Memphis, Tenn.

Ball, James Wesley (Jun. '35), Laboratory Asst. and Junior Engr., Hydr. Laboratory, U. S. Bureau of Reclamation, Colorado Agri. Coll. (Res., 307 Wayne St.), Fort Collins, Colo.

Barattini, Paul Anthony (Jun. '34), Wire Spinner, Triborough Bridge (Res., 194 Bleeker St.), New York, N.Y.

Bickford, Andrew Arthur (Assoc. M. '35), Mayor, and Director of Water Supplies, Municipality Guatemala, Guatemala.

Blume, John August (Jun. '35), With U. S. Coast and Geodetic Survey (Res., 4719 Geary Boulevard, Apartment 604), San Francisco, Calif.

Connell, Harry Hubert (Assoc. M. '35), Associate Engr., Wilson Eng. Co., 317 Farmers Union Bldg., Salina, Kans.

Eldridge, Clark Henry (M. '35), Engr., City of Seattle, City Engr's Office, County City Bldg., Seattle, Wash.

Etkes, Perez Willard (M. '35), Engr. in Chg., Haifa Dist., Dept. of Public Works, Palestine Govt., Box 502, Haifa, Palestine.

Friedewald, Frederick Roland (Assoc. M. '35), Asst. Supt. of Highways, St. Clair County Highway Dept., Belleville, Ill.

Gofseyeff, Samuel (Jun. '35), 490 Jefferson Ave., Brooklyn, N.Y.

Harkness, Frank Brace (Assoc. M. '35), Engr., U. S. Engr. Office, Eastport, Me.

Holzer, Frank (Assoc. M '35), Field Engr., Fay, Spofford & Thorndike, Boston (Res., 37 Cherry St., Quincy), Mass.

Inman, Charles Horace, Jr. (Jun. '35), 131 Washington St., Saratoga, N.Y.

Kaler, Stephen Scamman (Assoc. M. '35), Technical Clerk, Inspection Div. PWA (Res., 4418 Third St., N.W.), Washington, D.C.

Lazenby, Arthur J. (Jun. '35), Asst. San. Engr., Salt Lake City (Res., 451 Blaine Ave.), Salt Lake City, Utah.

MacBride, Earl Alexander (Jun. '35), Insp., State Highway Comm., 1907 North Illinois St., Indianapolis, Ind.

McClure, Thomas Mero (Assoc. M. '35), State Engr., Santa Fé, N.Mex.

Marby, Benjam'n Bradley (Jun. '35), Rodman, State Highway Dept. (Res., 1003 Fourth St.), Corpus Christi, Tex.

Miesenhelder, Paul David (M. '35), Box 261, Indianapolis, Ind.

Odom, Leo Myers (Assoc. M. '35), Res. Engr., Corps of Engrs., U.S.A., 1st New Orleans Dist., 604 Union Bldg., New Orleans, La.

Olsen, Ernest Harvey (Assoc. M. '35), Care Marr, Green & Opper, 400 North Michigan Ave., Chicago, Ill.

Pachon-Rojas, Luis (Jun. '35), 140 Newbury St., Boston, Mass.

Pedri, Henry Guido (Jun. '35), 500 Campus Ave., Pullman, Wash.

Rattner, Raymond (Jun. '35), Draftsman, CWA (Res., 246 East 199th St.), New York, N.Y.

Root, Ismar Earl (Jun. '35), Junior Asst. Engr., Grade 2, Jones Beach State Parkway Authority, Babylon, N.Y.

Rorhus, Nils (Assoc. M. '35), Structural Engr., Snow-Weaver Industrial Management, Inc. (Res., 2017 Chestnut St.), Harrisburg, Pa.

Rutt, Frank Edward (Jun. '35), Junior Engr., U. S. Engrs., U. S. Engr. Field Office, Genoa, Wis.

Saylor William Henry (Jun. '35), With Met. Water Dist. of Southern California (Res., 868½ Kensington Rd.), Los Angeles, Calif.

Shilstone, Herbert Maxwell, Jr. (Jun. '35), Building Materials Inst. and Testing Engr., Shilstone Testing Laboratory, 301 M & M Bldg., Houston, Tex.

Smith, Howard Wright (Jun. '35), Engr., Way and Structures, Kansas City Public Service Co. (Res., 6811 Penn St.), Kansas City, Mo.

Sower, James Edmund (Jun. '35), Junior Engr., U. S. Bureau of Reclamation (Res., 2167 South Ogden St.), Denver, Colo.

Stock, Eldon Mark (Jun. '35), Engr., FERA, Project 3-B9-92 (Res., 73 North 1st West), Logan, Utah.

Swiech, Paul Charles (Jun. '35), Transitman, Sewer Surveys, Pittsburgh (Res., 513 Sixth Ave., Carnegie), Pa.

Thomas, Francis (Jun. '35), Party Chf., Park Dept., Topographical Div. (Res., 14 West 76th St.), New York, N.Y.

Thompson, Robert Barker (Jun. '35), Research Asst., Civ. and San. Eng., Mass. Inst. Tech., Room 1-153, Mass. Inst. Tech., Cambridge, Mass.

Wang, Woodson (Assoc. M. '35), Chf. Engr., Grand Canal Comm. (Res., 30 Plum Garden, National Govt. Rd.), Nanking, China.

Warner, Roy Ferdinand (Jun. '35), Surveyman, Corps of Engrs., U.S.A.; 229 Grand Ave., Iowa City, Iowa.

Wilson, Henry Goeding Francis (Assoc. M. '34), Asst. Civ. Engr., Constr. Div., Q. M. C., U.S.A., Munitions Bldg. (Res., 1429 Madison St., N. W.), Washington, D.C.

Woster, Howard Cecil (Assoc. M. '35), Office Engr., Tacoma Dist., U. S. Geological Survey, 406 Federal Bldg., Tacoma, Wash.

Membership Transfers

Burke, Michael Joseph (Jun. '19; Assoc. M. '21; M. '35), Engr. of Structural Design, Outer Drive Impvt., Chicago Park Dist. (Res., 1441 Greenleaf Ave., Apartment 1 North), Chicago, Ill.

Cargill, Daniel Olney (Assoc. M. '31; M. '35), Bridge Engr., State Board of Public Roads, Bridge Dept.; Technical Advisor, Washington Bridge Comm.; R. 2, R.F.D. 2, Box 257, Valley Falls, R.I.

Combs, Lewis Barton (Assoc. M '27; M. '35), Lt.-Commander, C.E.C., U.S.N., Public Works Office, U. S. Navy Yard, Cavite, Philippine Islands.

DeWitt, John Ellingwood (Jun. '29; Assoc. M. '35), Appraisal Engr., Hine, Goldthwaite & Mylott, 7 Dey St., New York (Res., 10 Oakway, Scarsdale), N.Y.

Goodwin, Ralph Edward (Jun. '12; Assoc. M. 18; M. '35), Asst. Prof., Civ. Eng., School of Technology, Coll. of the City of New York, 139th St. and Convent Ave., New York, N.Y.

Harris, Harry Fallon (Assoc. M. '14; M. '35), County Engr., Mercer County, Court House (Res., 640 West State St.), Trenton, N.J.

Hicklin, Robert Guthrie (Assoc. M. '27; M. '35), Managing Engr., Municipal Dept., Robert & Co., Inc., 706 Bona Allen Bldg., Atlanta, Ga.

Jenkins, Carter (Assoc. M. '27; M. '35), Senior Eng. Insp., National Park Service, Dept. of Interior, 1526 Oakwood Ave., Des Plaines, Ill.

Knox, John James (Jun. '29; Assoc. M. '35), Asst. Engr., Interborough Rapid Transit Co., 2545 Seventh Ave., Room 310, New York (Res., 4256 Ketcham St., Elmhurst), N.Y.

McLean, Walter Reginald (Jun. '30; Assoc. M. '35), Asst. Engr., East Bay Municipal Utility Dist., Oakland (Res., 575 Broadmoor Boulevard, Broadmoor, San Leandro), Calif.

Meadowcroft, William (Assoc. M. '05; M. '35), Eng. Consultant, Inst. of Public Administration, 320 East 35th St. (Res., 434 West 120th St.), New York, N.Y.

Middlebrooks, Thomas Alwyn (Jun. '31; Assoc. M. '35), Associate Engr., U. S. Engrs. (Res., 231 Milk River Rd.), Fort Peck, Mont.

Myers, Clyde (Assoc. M. '20; M. '35), Prof. of Civ. Eng. and Director of Eng., Phoenix Junior Coll. (Res., 414 North Madrona St.), Phoenix, Ariz.

Page, Austin Elmer (Assoc. M. '30; M. '35), Dist. Engr., The Lane Constr. Corporation, 3 Kent St., Concord, N.H.

TOTAL MEMBERSHIP AS OF JULY 9, 1935

Members	5,702
Associate Members	6,159
Corporate Members	11,861
Honorary Members	18
Juniors	3,078
Affiliates	98
Fellows	2
Total	15,057

Perrey, Joseph Irving (Jun. '27; Assoc. M. '35), Associate Engr., Water Resources Branch, U. S. Geological Survey, 217 Post Office Bldg., Chattanooga, Tenn.

Rawhouser, Clarence (Jun. '30; Assoc. M. '35), Asst. Engr., U. S. Bureau of Reclamation, Customhouse, Denver, Colo.

Richards, Guy (Jun. '30; Assoc. M. '35), Asst. Res. Engr., Sir Alexander Gibb & Partners, Strathearn, New Galloway, Kirkcudbrightshire, Scotland.

Sánchez, Milciades (Jun. '27; Assoc. M. '35), Gen. Mgr., Public Utilities, City of Medellin, Medellin, Colombia.

Schmidt, Robert Alan (Jun. '28; Assoc. M. '35), Asst. Engr., Eng. Dept., New York and Queens Elec. Light & Power Co., 40-22 Lawrence St., Flushing (Res., 1576 East 45th St., Brooklyn), N.Y.

Steenbergen, William Arthur (Jun. '30; Assoc. M. '35), Instr. and Asst. Agri. Engr., Agri. Experiment Station, Univ. of Arizona (Res., 304 North Fremont), Tucson, Ariz.

Wessenauer, Gabriel Otto (Jun. '27; Assoc. M. '35), Asst. Engr., The West Penn Elec. Co., 14 Wood St., Pittsburgh (Res., 530 Centennial Ave., Sewickley), Pa.

Wu, King Ching (Jun. '27; Assoc. M. '35), Designing Engr. and Treas., Cosmos Eng. Co., Ltd., (Res., 84, Ming Teh Lee, 687 Ave. Foch, French Concession), Shanghai, China.

Reinstatements

Bellamy, Earl DeLaine, Jun., reinstated July 8, 1935.

Buys, Cornelius Kouwenhoven, Jun., reinstated June 25, 1935.

Gates, Howard Babcock, Jr., Jun., reinstated June 18, 1935.

Greene, William Jeff, Assoc. M., reinstated July 5, 1935.

Heins, Henry, M., reinstated June 11, 1935.

Schneider, Floyd Edward, Jun., reinstated June 27, 1935.

Witzel, Stanley Arthur, Jun., reinstated June 12, 1935.

Resignations

Fernstrom, John Archie, Jun., resigned June 28, 1935.

Ponco, Jacinto Samonte, Assoc. M., resigned June 7, 1935.

Sloan, Samuel Alan, Assoc. M., resigned June 7, 1935.

Stoll, Jay Hostetter, Assoc. M., resigned June 19, 1935.

Yen, Te-Ching Strong, M., resigned June 17, 1935.

Young, Jacob Clough, Jun., resigned June 7, 1935.

Deaths

Boyle, James Alphonsus. Elected Assoc. M. Aug. 31, 1915; died June 20, 1935.

Compton, Ruel Keith. Elected M. Nov. 12, 1913; died June 21, 1935.

Fuller, Weston Earle. Elected Assoc. M. June 7, 1905; M. Dec. 3, 1912; died June 22, 1935.

Futami, Kyosaburo. Elected Affiliate June 5, 1889; died Feb. 10, 1931.

Morrison, Robert Orrell. Elected Assoc. M. April 1, 1914; died Feb. 13, 1934.

Sims, Clifford Stanley. Elected M. April 1, 1903; died January 1935.

Swigert, Charles Frederick. Elected M. June 4, 1928; died June 23, 1935.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment of Members to Board of Direction

August 1, 1935 NUMBER 8

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years*	5 years of important work
Associate Member	Qualified to direct work	27 years	8 years*	1 year
Junior	Qualified for sub-professional work	20 years†	4 years*	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years*	5 years of important work
Fellow	Contributor to the permanent funds of the Society			

* Graduation from an engineering school of recognized reputation is equivalent to 4 years of active practice.

† Membership ceases at age of 33 unless transferred to higher grade.

The fact that applicants refer to certain members does not necessarily mean that such members endorse.

FOR ADMISSION

ALEXANDER, ANDREW, Arlington, N.J. (Age 21.) Refers to C. T. Schwarze, D. S. Trowbridge.

BAFFA, JOHN JOSEPH, Brooklyn, N.Y. (Age 21.) Refers to H. R. Codwise, H. P. Hammond.

BAGDADI, MAHMUT, Adana, Turkey. (Age 25.) Refers to C. A. Ellis, W. K. Hatt.

BARNES, WILLIAM FRANCIS, JR., Chicago, Ill. (Age 22.) Refers to J. J. Doland, M. L. Enger.

BEIER, HERBERT DONALD, New York City. (Age 21.) Refers to F. O. X. McLoughlin, J. C. Rathbun.

BELFORD, HUGH BRICE, Keokuk, Iowa. (Age 44.) With Cameron, Joyce & Co., Gen. Contrs. Refers to C. Ash, M. D. Catton, C. M. Hathaway, A. H. Hunter, A. Richards, W. M. Spann, R. A. Trufant, E. C. L. Wagner.

BELL, HAROLD BRADFORD, Leominster, Mass. (Age 23.) Refers to A. W. French, J. W. Howe, C. F. Meyer.

BENJES, HENRY HERMAN, Kansas City, Mo. (Age 21.) Refers to G. W. Bradshaw, W. C. McNown.

BENSON, FRED JACOB, Topeka, Kans. (Age 20.) Refers to L. E. Conrad, F. W. Epps, F. F. Frazier.

BERKOWITZ, SIDNEY ADRIAN, Key West, Fla. (Age 21.) Refers to C. C. Brown, R. M. Johnson, T. M. Lowe, P. L. Reed, W. L. Sawyer.

BISSO, GEORGE SIDNEY, New Orleans, La. (Age 23.) Refers to E. S. Bres, D. Derickson, J. H. O'Neill.

BLASER, JAMES ARNOLD, Rock Island, Ill. (Age 21.) Refers to J. C. L. Fish, C. Moser, L. B. Reynolds, E. C. Thomas, J. B. Wells.

BLISS, HAROLD PAUL, Los Angeles, Calif. (Age 47.) Asst. Civ. Engr., Dept. of Water & Power. Refers to E. A. Bayley, W. W. Hurlbut, R. R. Proctor, A. E. Sedgwick, H. A. Van Norman.

BOSWORTH, LEWIS ALBA, Rochester, N.Y. (Age 21.) Refers to A. J. Decker, C. T. Johnston, H. W. King, L. C. Maugh, R. H. Sherlock, C. O. Wisler.

BRAUN, HOWARD CLYDE, JR., Dayton, Ohio. (Age 23.) Refers to C. A. Ellis, R. B. Wiley.

BRIEFER, JUSTIN HARRIS, New York City. (Age 25.) Refers to W. F. Jenrick, P. W. Norton, C. M. Spofford.

BROYLES, HARMON CLETUS, Blacksburg, Va. (Age 22.) Refers to R. B. H. Begg, F. J. Sette.

BURKY, JOHN DRUMMOND, Denver, Colo. (Age 22.) Refers to C. R. Burky, R. L. Downing, C. L. Eckel.

CAIN, VERNON Y, Lufkin, Tex. (Age 23.) Refers to J. T. L. McNew, J. J. Richey.

CAPP, MARTIN PHILIP, Denver, Colo. (Age 22.) Refers to R. L. Downing, C. L. Eckel.

CARTER, WILLIAM RICHARD, Omaha, Nebr. (Age 22.) Refers to G. W. Bradshaw, W. C. McNown, F. A. Russell.

CLEMENT, BLANTON, Madison, Ga. (Age 28.) Jun. Project Mgr., Land Program Div., National Park Service. Refers to J. G. Beacham, A. P. Bursley, H. D. Cutter, Jr., S. B. Slack, C. M. Strahan.

CLERICUZIO, SARAFINO JAMES, Bloomfield, N.J. (Age 22.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

COLLIER, WILLIAM PRESCOTT, Bellingham, Wash. (Age 23.) Refers to H. E. Phelps, M. K. Snyder, J. G. Woodburn.

CONWAY, NORMAN BUTLER, Ft. Defiance, Ariz. (Age 49.) Road Engr., Southern Navajo Agency, U. S. Indian Service. Refers to L. C. Hill, R. A. Hill, W. Johannessen, L. M. Lawson, T. Maddock, H. C. Neuffer, P. J. Preston.

CORWIN, MERTON DUDLEY, Jamestown, N.Y. (Age 22.) Refers to H. B. Luther, R. W. Renn.

CSANYI, LADIS HENRY, Jamaica, N.Y. (Age 32.) Eng. Asst., Div. of Design, Dept. of Public Works, Manhattan, New York City. Refers to C. P. Berkey, A. Dick, J. Friedland, J. J. Murphy, C. M. Pinckney, B. Schwerin.

CULLEN, WILLIAM PATRICK, New Orleans, La. (Age 27.) Refers to E. S. Bres, D. Derickson, J. H. O'Neill.

DAYSON, ARTHUR RAYMOND, Gainesville, Fla. (Age 23.) Refers to R. M. Johnson, T. M. Lowe, P. O. Reed, W. L. Sawyer.

DE GENNARO, PETER FRANK, Arlington, N.J. (Age 22.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

DE JULIO, FREDERICK JOHN, Brooklyn, N.Y. (Age 22.) Refers to H. P. Hammond, L. F. Rader, E. J. Squire.

DELAPP, WARREN WILLIAM, TOPEKA, KANS. (Age 23.) Refers to L. E. Conrad, E. R. Dawley, F. F. Frazier.

DEL FAVERO, LOUIS VINCENT, Columbia, N.J. (Age 29.) Refers to M. O. Fuller, C. H. Sutherland.

DEMLER, LESTER ERNEST, North Tonawanda, N.Y. (Age 22.) Refers to G. E. Barnes, G. B. Earnest, F. L. Plummer, W. E. Rice.

DEVORE, RODNEY WALTER, Meadville, Pa. (Age 22.) Refers to L. M. Gram, C. T. Johnston, R. H. Sherlock.

DOAK, JOHN, Urbana, Ill. (Age 33.) Asst. Supt. of Bldgs., Univ. of Illinois. Refers to M. L. Enger, W. D. Gerber, H. H. Jordan. F. E. Richart, T. C. Shedd, J. E. Smith, H. L. White.

DOWNE, CHARLES EDWARD, New Haven, Conn. (Age 23.) Asst. Estimator, FERA, New Haven, Conn. Refers to C. T. Bishop, C. S. Farnham, P. G. Laurson, R. H. Suttie, J. C. Tracy.

DUNN, ROBERT, Clifton, N.J. (Age 29.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

EAST, HUDSON CLAIBORNE, Lake Charles, La. (Age 21.) Refers to C. D. Gibson, F. C. Snow.

EDMANDS, HORACE JOHN, Sault Ste. Marie, Mich. (Age 22.) Refers to W. C. Hoad, H. W. King, L. C. Maugh, R. H. Sherlock, C. O. Wisler.

EDMONDS, DONALD JOHN, Brooklyn, N.Y. (Age 21.) Refers to H. P. Hammond, L. F. Rader.

EMERSON, CHARLES EDWARD, Arlington, N.J. (Age 25.) Refers to H. N. Cummings, W. S. LaLonde, Jr., F. Williams.

ENGLISHMAN, HERBERT KRINE, Paterson, N.J. (Age 24.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

ENNS, EVERETT BYRON, Windom, Minn. (Age 26.) Refers to F. Base, A. S. Cutler, O. M. Leland, L. G. Straub, W. H. Wheeler.

ESCHEN, FRANKLIN WILLIAM, JR., Sloatsburg, N.Y. (Age 22.) Refers to C. T. Bishop, T. Crane.

FADUM, EIGIL RALPH, Niagara Falls, N.Y. (Age 23.) Refers to H. Cross, J. J. Doland, M. L. Enger, W. C. Huntington. H. H. Jordan, T. C. Shedd, A. N. Talbot.

Ferguson, Gerald Wellington, Brewster, N.Y. (Age 22.) Refers to H. C. Bird, W. H. Hall.

Fitzgerald, James Augustine, Ravenna, Ohio. (Age 23.) Refers to G. E. Barnes, G. B. Earnest, F. L. Plummer, W. E. Rice, G. B. Sowers.

Fox, Frederick Jay, New York, N.Y. (Age 40.) Engr., Machlin Bros. & Bassow, Bronx. Refers to W. R. Bascome, B. Braslow, F. S. Childs, A. Dick, J. Feld, and W. A. Hardenbergh.

Fricker, Frank Fred, Akron, Ohio. (Age 22.) Refers to F. E. Ayer, J. W. Bulger, R. C. Durst.

Fritzinger, George Frank, Belleville, Ill. (Age 22.) Refers to N. D. Morgan, C. E. Palmer.

Fuller, Robert William, San Antonio, Tex. (Age 25.) Refers to J. T. L. McNew, T. A. Munson.

Fusco, James John, Glens Falls, N.Y. (Age 22.) Refers to A. J. Decker, L. M. Gram.

Gable, Elmer William, Tonawanda, N.Y. (Age 28.) With War Dept., U. S. Engrs., Buffalo, N.Y. Refers to L. W. Clark, T. R. Lawson, H. C. Woods.

Goodhart, Morris, Pikesville, Md. (Age 21.) Refers to P. G. Crout, J. H. Gregory, J. T. Thompson.

Granberg, Robert James, Buzzard's Bay, Mass. (Age 22.) Refers to J. B. Babcock, 3d, C. B. Breed, W. C. Voss.

Granger, Raymond Oscar, Worcester, Mass. (Age 23.) Refers to A. W. French, J. W. Howe, A. J. Knight, C. F. Meyer, H. F. Taylor.

Graves, Joseph Whitaker, Jr., St. Louis, Mo. (Age 21.) Refers to C. E. Galt, W. W. Horner, E. O. Sweetser.

Gross, Charles Edward, Carlisle, Ohio. (Age 20.) Refers to C. J. Belz, J. J. Chamberlain, Jr.

Habig, William Albert, Newark, N.J. (Age 23.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

Haines, Reuben Matter, Dowagiac, Mich. (Age 28.) Rodman, U. S. Geological Survey, Dept. of Interior. Refers to C. B. Breed, T. R. Camp, G. Gilboy.

Harper, Donald Arthur, Napoleon, Ohio. (Age 21.) Refers to C. A. Ellis, R. B. Wiley.

Harrod, Jack, Jr., Ashley, Mich. (Age 23.) Refers to W. J. Emmons, L. M. Gram, C. T. Johnston.

Haselwood, Robert Walter, Redding, Calif. (Age 21.) Refers to L. B. Reynolds, E. C. Thomas.

Hauer, Gerald Elton, Grand Rapids, Mich. (Age 22.) Refers to L. M. Gram, R. H. Sherlock.

Hedding, Joseph Albertus, Minneapolis, Minn. (Age 23.) Refers to F. Bass, A. S. Cutler, L. G. Straub.

Hegy, William Zolton, San José, Calif. (Age 20.) Refers to J. C. L. Fish, E. L. Grant, C. Moser, L. B. Reynolds, J. B. Wells, H. A. Williams.

Henderson, Harold Rains, Marshall, Tex. (Age 28.) County Engr., Harrison County, Tex. Refers to W. D. Dockery, A. D. Hutchison, W. A. Ortolani.

Hendrick, Jasper Reginald, Ft. Worth, Tex. (Age 21.) Refers to L. E. Grinter, J. T. L. McNew, T. A. Munson, J. J. Richey.

Hill, Randolph William, Los Angeles, Cal. (Age 23.) Refers to E. L. Grant, E. C. Thomas, J. B. Wells.

Hinton, Howard Mayfield, Atlanta, Ga. (Age 23.) Refers to R. P. Black, F. C. Snow.

Hitter, Aaron, New York City. (Age 21.) Refers to R. E. Goodwin, J. C. Rathbun.

Holley, Robert Paul, LaFollette, Tenn. (Age 33.) Asst. Highway Engr., TVA. Refers to B. A. Batson, C. A. Baughman, J. W. Bradner, Jr., J. A. C. Callan, H. H. Houk, R. D. Jordan, B. L. Moore.

Holober, David George, Brooklyn, N.Y. (Age 23.) Refers to H. P. Hammond, E. J. Squire.

Hummel, John Lucien, Albany, Ga. (Age 29.) Dist. Superv. Engr., U. S. Coast & Geodetic Survey, Local Control Surveys. Refers to J. A. Higgs, Jr., J. deB. Kops, F. H. McDonald, C. C. Whitaker, C. W. Wright.

Jacobson, Harold, New York City. (Age 21.) Refers to H. E. Breed, C. T. Schwarze.

Janvier, George, Jr., New Orleans, La. (Age 21.) Refers to E. S. Bres, D. Derickson, J. H. O'Neill.

Jewell, Wendell Denning, Providence, R.I. (Age 20.) Refers to A. W. French, J. W. Howe.

Johnson, Alfred Massey Fisher, Chattanooga, Tenn. (Age 23.) Draftsman, TVA. Refers to C. L. Allen, W. I. Stemwell.

Johnson, Lee Harnie, Jr., Vicksburg, Miss. (Age 26.) With U. S. Waterways Experiment Station. Refers to G. M. Fair, A. Haertlein, L. B. Ryon, Jr.

Johnston, James Alexander, Lubbock, Tex. (Age 21.) Refers to O. V. Adams, J. H. Murdough, G. W. Parkhill.

Johnston, Roy Gunnar, Alhambra, Calif. (Age 21.) Refers to R. M. Fox, D. M. Wilson.

Jones, Jo Buck, Austin, Tex. (Age 37.) At present State Engr. for Transient Div., Texas Relief Comm. Refers to E. A. Baugh, J. C. Bisset, C. C. Crew, L. H. Dodd, F. O. Fernald, J. Lansdale, E. S. Thomas.

Jung, Eugene Edward, San José, Calif. (Age 25.) Refers to E. L. Grant, A. S. Niles, L. B. Reynolds, E. C. Thomas, J. B. Wells.

Karp, Nathan, Hollywood, Cal. (Age 27.) Refers to R. R. Martel, W. W. Michael, F. Thomas.

Klahn, Sidney William, Salem, Ore. (Age 29.) Field Engr., Pure Iron Culvert & Mfg. Co., Portland, Ore. Refers to H. M. Chadwick, J. R. Griffith, G. W. Holcomb, C. A. Mockmore, H. S. Rogers, S. H. Sims.

Krahmer, Edward August, New York City. (Age 22.) Refers to C. T. Schwarze, D. S. Trowbridge.

Krohn, August Frederick, New York City. (Age 20.) Refers to A. Haring, C. T. Schwarze, D. S. Trowbridge.

Ladue, William Edward, Sacramento, Calif. (Age 23.) Refers to E. L. Grant, A. S. Niles, L. B. Reynolds, A. L. Trowbridge, J. B. Wells.

Laflin, William Alan (Age 35). Hydr. Engr., El Paso County Water Dist. No. 1, and Elephant Butte Irrigation Dist. (Rio Grande Project, New Mexico and Texas), Refers to H. Barnes, H. Conkling, W. C. Hammatt, S. T. Harding, R. Matthew, F. H. Tibbetts, D. R. Warren.

Leba, Theodore, Jr., Newark, N.J. (Age 22.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

Le Doux, Joseph McLean, New Orleans, La. (Age 35.) Asst. Engr., Drainage Dept., Sewerage & Water Board of New Orleans. Refers to C. G. Cappel, R. E. Gosa, R. L. Moroney, A. J. Negrotto, A. F. Theard, W. H. Williams, J. K. Woolf.

Lierboe, Rinard Theodore, Jr., Devils Lake, N. Dak. (Age 22.) Dist. Engr., U. S. Govt., Work Div. FERA, Bismarck, N. Dak. Refers to A. Boyd, E. F. Chandler.

Lindl, Gordon Joseph, Kenosha, Wis. (Age 22.) Refers to J. J. Doland, N. D. Morgan.

Linkletter, Alfred Clinton, Jersey City, N.J. (Age 23.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

Lischer, Alan Arthur, St. Louis, Mo. (Age 24.) Refers to W. W. Horner, E. O. Sweetser.

Liu, Te-Yun, Iowa City, Iowa. (Age 24.) Refers to J. W. Howe, B. J. Lambert, S-T. Li, F. T. Mavis, A. F. Meyer, E. L. Waterman, H. E. Wessman, C. C. Williams, S. M. Woodward.

Loveless, Compere, West Lafayette, Ind. (Age 21.) Refers to C. A. Ellis, R. B. Wiley.

Lyles, William Murray, Jr., Lafayette, Ind. (Age 24.) Eng. Aide., Design Dept., Indiana Highway Comm. Refers to C. A. Ellis, R. B. Wiley.

Lynn, Patrick Ignatius, Houston, Tex. (Age 28.) Refers to J. T. L. McNew, T. A. Munson.

Lynn, Woodrow Lawrence, Tampa, Fla. (Age 21.) Refers to C. C. Brown, T. M. Lowe, P. L. Reed.

MacGregor, Arthur Sidney, Albion, N.Y. (Age 44.) Engr. of Bldg. Constr., New York State Dept. of Public Works. Refers to W. H. Adams, C. L. Allen, G. H. Fenkell, H. S. Grassman, J. T. N. Hoyt, W. R. Kales, W. A. Nial.

MacLaughlin, Walter Scott, Belleville, N.J. (Age 24.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

McClarran, William Harry, Cleveland, Ohio. (Age 23.) Refers to G. E. Barnes, G. B. Earnest, F. L. Plummer, W. E. Rice, G. B. Sowers.

McDill, William Howard, Rolla, Mo. (Age 24.) Recorder (Draftsman), U. S. Geological Survey, Topographic Div. Refers to C. E. S. Bardsley, H. C. Beckman, J. B. Butler, E. W. Carlton, E. G. Harris.

McDowell, Robert Charles, Dixon, Ky. (Age 22.) Refers to W. J. Carrel, D. V. Terrell, J. S. Watkins.

McKim, Robert Dan, Kansas City, Mo. (Age 30.) Designer, Black & Veatch, Cons. Engrs. Refers to E. Boyce, W. C. McNown, F. A. Russell.

Makela, George Allan, Fitchburg, Mass. (Age 21.) Refers to A. W. French, A. J. Knight.

Marchetti, Aldo, Corona, N.Y. (Age 24.) Refers to H. R. Codwise, H. P. Hammond.

Martin, James Allan, West Lafayette, Ind. (Age 23.) Refers to C. A. Ellis, R. B. Wiley.

Masi, Felix Joseph, Summit, N.J. (Age 21.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

Mathewson, Charles Ellis, Jr., New York City. (Age 22.) Refers to T. Saville, C. T. Schwarze.

Matthews, Alexander, Jr., Elmhurst, N.Y. (Age 21.) Refers to C. J. Tilden, J. C. Tracy.

Melville, Cyril Glennon, New Orleans, La. (Age 38.) Res. Engr., Modjeski, Masters & Case, Inc., Cons. Engrs. Refers to M. B. Case, J. F. Coleman, D. Derickson, J. L. de Vou, R. H. Lee, F. M. Masters, R. Modjeski, O. A. Zimmerman.

Nedbor, Eugene, Brooklyn, N.Y. (Age 22.) Computer, U. S. Coast and Geodetic Survey. Refers to C. B. Breed, R. L. Pfau.

Nelson, George Albert, Chicago, Ill. (Age 23.) At present Aeronautical Engr. for Ben. O. Howard, design analyses on proposed planes. Refers to E. S. Nethercut, G. L. Opper, T. F. Wolfe.

Neubecker, Lincoln Carl, Lakewood, Ohio. (Age 23.) Refers to G. E. Barnes, G. B. Earnest, F. L. Plummer, G. B. Sowers.

Nixon, Eager Wooldridge, Wooldridge, Mo. (Age 22.) Refers to C. E. S. Bardsley, J. B. Butler, E. W. Carlton.

Nussbaum, Joseph Randall, Denver, Colo. (Age 25.) Refers to R. L. Downing, C. L. Eckel.

O'Neall, Albert Ellis, Green Cove Springs, Fla. (Age 26.) Refers to R. M. Johnson, T. M. Lowe, N. R. Moore, P. L. Reed, W. L. Sawyer, C. H. Shea, C. W. Ullom.

Oppenheim, James Randolph, Houston, Tex. (Age 22.) Refers to L. E. Grinter, J. J. Richey, C. E. Sandstedt.

Osterlund, Arnold Charles, Jr., Hackensack, N.J. (Age 21.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

Overton, Elting Fillmore, Orange, N.J. (Age 29.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

Owens, Parry William, Whitesboro, N.Y. (Age 22.) Refers to E. F. Berry, E. F. Church, L. Mitchell, S. D. Sarason.

Owens, Thomas Milton, Brooklyn, N.Y. (Age 20.) Refers to A. Haring, T. Saville, C. T. Schwarze, D. S. Trowbridge.

Paul, Gordon Leonard, Providence, R.I. (Age 23.) Refers to C. D. Billmyer, J. L. Murray.

Perry, Francis Edward, Worcester, Mass. (Age 33.) Asst. County Engr., Worcester County. Refers to C. M. Allen, A. W. French, J. A. Johnston, A. J. Knight, L. O. Marden, L. W. West.

Phillips, George William, McConnelsville, Ohio. (Age 36.) Jun. Engr., U. S. Engr. Office, Zanesville, Ohio. Refers to A. L. Alin, C. Johnston, S. Macomber, N. R. Moore, G. M. Tapley, E. L. Winslow, Jr., L. R. Young.

Powell, Carl William, West Lafayette, Ind. (Age 23.) Draftsman, State Highway Comm. of Indiana, Indianapolis, Ind. Refers to C. A. Ellis, G. P. Springer.

Powell, Waldo Stanislaus, Jr., New Orleans, La. (Age 22.) Refers to E. S. Bres, D. Derickson, J. H. O'Neill.

Prahl, Charles George, Coulee Dam, Wash. (Age 22.) Rodman, U. S. Bureau of Reclamation. Refers to F. A. Banks, J. R. Griffith, C. A. Mockmore.

Quinn, James Bernard, Balboa Heights, Canal Zone. (Age 23.) Refers to J. C. Claybourn, C. A. Ellis, R. B. Wiley.

Ramseier, Roy Edwin, Berkeley, Calif. (Age 23.) At present Draftsman, Alameda County Mosquito Abatement. Refers to C. Derleth, Jr., C. G. Hyde, B. Jameyson.

Redmile, Harold Franklin, Wilmington, Del. (Age 22.) Refers to T. D. Mylrea, H. K. Preston.

Redon, Alexander Louis, New Orleans, La. (Age 25.) Inspector of dredging, U. S. Engrs., Second New Orleans Dist. Refers to D. Derickson, W. B. Gregory.

Reinhard Felten, Wilhelm Bernhard, Hinsdale, Mass. (Age 21.) Refers to L. W. Clark, T. R. Lawson, H. O. Sharp.

River, Robert Beaudon, Chicago, Ill. (Age 28.) Refers to J. G. Bennett, M. W. Ellis, W. H. Smith.

Roehrig, Harold August, Detroit, Mich. (Age 21.) Refers to F. P. Dillon, L. M. Gram.

Rogers, Bob Killough, St. Louis, Mo. (Age 22.) Refers to C. E. Galt, W. W. Horner, E. O. Sweetser.

Ruddy, John William, New York City. (Age 26.) Refers to E. J. Carrillo, P. D. G. Hamilton, L. Hussey, C. S. Joslyn, R. O'Donnell, H. B. Shattuck, E. D. Walker.

Russi, Robert Wilson, Houston, Tex. (Age 22.) Refers to L. E. Grinter, J. T. L. McNew, T. A. Munson, J. J. Richey, C. E. Sandstedt.

Schleiter, Howard William, St. Paul, Minn. (Age 22.) Refers to F. Bass, A. S. Cutler, L. G. Straub.

Schlesinger Max, Chicago, Ill. (Age 25.) Refers to H. E. Babbitt, H. Cross, J. J. Doland, W. C. Huntington, T. C. Shedd.

Schrenk, George Staehle, New Orleans, La. (Age 21.) Refers to E. S. Bres, D. Derickson, J. H. O'Neill.

Settoon, William Barret, New Orleans, La. (Age 22.) Refers to E. S. Bres, D. Derickson, J. H. O'Neill.

Shephard, Robert Owen, Meridian, Miss. (Age 23.) Refers to A. B. Hargis, R. B. B. Moorman.

Sheridan, Robert Roe, Piqua, Ohio. (Age 24.) Refers to F. A. Barnes, J. E. Perry, R. Y. Thatcher.

Silberman, Edward, Minneapolis, Minn. (Age 21.) Refers to F. Bass, A. S. Cutler, O. M. Leland, L. G. Straub.

Sinacori, Mariano Nicholas, Brooklyn, N.Y. (Age 24.) Refers to A. H. Beyer, W. J. Krefeld.

Sklar, Samuel Elliot, Brooklyn, N.Y. (Age 25.) Draftsman with Gibbs & Hill, Cons. Engrs., New York City. Refers to H. P. Hammond, E. J. Squire.

Sloat, James Walter, Portland, Ore. (Age 22.) Refers to J. R. Griffith, G. W. Holcomb, C. A. Mockmore.

Smedegaard, Maurice Godfred, Denver, Colo. (Age 23.) Refers to R. L. Downing, C. L. Eckel.

Sottosanti, John Sebastian, Greenwich, Conn. (Age 21.) Refers to F. E. Foss, A. P. Richmond, Jr., J. P. J. Williams.

Stirton, John Arthur, New York City. (Age 24.) Refers to R. E. Goodwin, F. O. X. McLoughlin.

Sumrall, Clinton Lafayette, Jr., Laurel, Miss. (Age 23.) Refers to A. B. Hargis, R. B. B. Moorman.

Sweeton, Arthur Watson, 3d, Collinsville, Conn. (Age 22.) Refers to R. H. Suttie, J. C. Tracy.

Swift, Dean Edwin, Topeka, Kans. (Age 23.) Refers to L. E. Conrad, M. W. Furr, L. Grover.

Swinney, Leonard Robert, Baton Rouge, La. (Age 23.) Refers to E. S. Bres, D. Derickson, J. H. O'Neill.

Taylor, Leslie Seymour, Beachwood, N.J. (Age 28.) Engr., U. S. Coast and Geodetic and State Survey. Refers to J. F. W. Gebhardt, P. Kissam, C. Lawrence, E. Pendlebury, E. E. Sousley.

Tennant, William Walton, Baton Rouge, La. (Age 47.) Head, Coordination Div., Standard Oil Co. of Louisiana. Refers to C. G. Cappel, R. E. Gosa, B. W. Pegues, W. H. Williams, J. K. Woolf.

Thompson, Jesse Neils, Bay City, Tex. (Age 22.) Graduate Student, University of Texas. Refers to P. M. Ferguson, S. P. Finch, J. A. Focht, E. N. Gustafson.

Turken, Morris William, St. Louis, Mo. (Age 23.) Refers to C. E. S. Bardsley, J. B. Butler, E. W. Carlton.

Van Camp, Channing Pollock, San Francisco, Calif. (Age 25.) Jun. Topographic Engr., U. S. Geological Survey. Refers to R. T. Evans, H. H. Hodgeson.

Vander Velde, Theodore Louis, Grand Rapids, Mich. (Age 24.) Refers to A. J. Decker, W. C. Hoad.

Van Horn, Harold Leroy, West Lafayette, Ind. (Age 24.) Refers to C. A. Ellis, G. P. Springer.

Venard, John Victor, Ulysses, Kans. (Age 28.) Concrete Inspector, Grade A, Constr. Dept., Kansas Highway Comm. Refers to H. Allen, L. E. Conrad, E. R. Dawley, F. F. Frazier, M. W. Furr, R. C. Ham, J. A. Roby, C. H. Scholer.

Wagner, Raymond Francis, Sunbury, Pa. (Age 23.) Refers to G. M. Fair, R. O'Donnell, E. D. Walker.

Walker, Allan Pearson, New York City. (Age 25.) Engr. with F. O. Anderegg, Ph.D., Specialist in Bldg. Materials. Refers to L. W. Clark, H. O. Sharp.

Warren, Frank Louis, Litchfield, Ill. (Age 23.) Refers to W. C. Huntington, W. A. Oliver, C. C. Wiley.

Washington, Courtenay Cleveland, Galveston, Tex. (Age 52.) Refers to G. Gilchrist, C. R. Haile, J. M. Howe, W. Mueser, C. V. Seastone, J. L. Starkie, R. A. Thompson, J. Vawter, W. O. Washington, G. G. Wickline, A. J. Wise.

Wasson, Maurice Wayne, Jr., Pittsburgh, Pa. (Age 21.) Refers to A. Diefendorf, L. C. McCandliss.

Weinkauff, William Christian, Glendale, N.Y. (Age 28.) Refers to H. P. Hammond, E. J. Squire.

Weisser, George Albert, Carnegie, Okla. (Age 24.) Refers to J. F. Brookes, N. E. Wolfard.

Winters, Robert John, Jr., East Orange, N.J. (Age 21.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

Wiskocil, Clement Tehle, Berkeley, Calif. (Age 45.) Associate Prof. of Civ. Eng., Univ. of California. Refers to R. E. Davis, C. Derleth, Jr., B. A. Etcheverry, S. T. Harding, C. G. Hyde, L. R. Jorgensen, F. C. Scobey.

Witt, John Vanderhoof, Los Angeles, Calif. (Age 45.) With Los Angeles Dept. of Water and Power. Refers to E. A. Bayley, J. G. Claybourn, R. L. Derby, N. M. Imbertson, H. L. Jacques, J. E. Jones, D. A. Lane, S. B. S. Nelson, R. R. Proctor.

Wojcik, Theodore Augustus, Cleveland, Ohio. (Age 21.) Refers to G. E. Barnes, G. B. Earnest, F. L. Plummer, W. E. Rice, G. B. Sowers.

Wood, Melville Cronkrite, Sag Harbor, N.Y. (Age 24.) Refers to P. L. Reed, W. S. Sawyer.

Woodward, Richard Lewis, Ferguson, Mo. (Age 21.) Refers to W. W. Horner, E. O. Sweetser.

Yoder, Charles William, Philadelphia, Pa. (Age 24.) Asst. Engr., Operating Dept., Pennsylvania Shipping Co. (tanker shipping). Refers to A. Z. Hoffman, C. A. Howland, R. O'Donnell, H. B. Shattuck, E. D. Walker.

Zebroski, John Howard, Babylon, N.Y. (Age 23.) Refers to W. D. Ayers, F. C. Wilson.

Zilly, Herbert Carl, Aurora, Ill. (Age 22.) Refers to H. Cross, T. C. Shedd.

FOR TRANSFER

FROM THE GRADE OF ASSOCIATE MEMBER

Baylor, Robert Emmet, Assoc. M., Potrerillos, Chiriqui, Panama. (Elected July 12, 1926.) (Age 44.) Mgr., Herrera Sugar Co. Refers to M. R. Alexander, D. G. Coombs, H. M. Dougherty, J. G. Lott, W. E. Rudolph, M. W. Sample, T. D. Sawyer.

Boggs, Wallace Bradford, Assoc. M., Oakland, Cal. (Elected Aug. 31, 1925.) (Age 43.) Civ. Engr. Refers to C. Derleth, Jr., H. F. Gray, C. G. Hyde, A. Kempkey, C. H. Lee, C. H. Sweetser, G. D. Whittle.

Bonney, Guy, Assoc. M., Frostburg, Md. (Elected March 11, 1919.) (Age 48.) Res. Engr. Inspector, FEA of PW. Refers to J. H. Bowditch, A. Davis, J. K. Flick, L. A. Jenny, W. W. Stone, E. Sudler, J. L. Vogel.

Corwin, Thornton Johnson, Jr., Assoc. M., San Francisco, Calif. (Elected Junior Oct. 15, 1923; Assoc. M. Nov. 15, 1926.) (Age 36.) Asst. Engr., Pacific Gas & Elec. Co. Refers to W. Dreyer, B. A. Etcheverry, W. L. Huber, A. H. Markwart, F. C. Scobey, I. C. Steele.

Eickelberg, Ernest Werner, Assoc. M., Washington, D.C. (Elected April 25, 1921.) (Age 45.) Asst. Chf., Div. of Terrestrial Magnetism and Seismology, U. S. Coast and Geodetic Survey. Refers to F. S. Borden, W. Bowie, C. L. Garner, J. H. Hawley, N. H. Heck, P. H. Underwood.

Galvin, Charles Broe, Assoc. M., New York City. (Elected March 15, 1926.) (Age 62.) Asst. Engr. (with office title of Div. Engr.), City of New York, Dept. of Docks. Refers to W. T. Doran, J. P. Hogan, C. R. Hulsart, J. P. Hurley, R. Ridgway, W. E. Swift, W. H. Yates.

Joyner, Calvin Nicolas, Assoc. M., Tientsin, China. (Elected Junior April 18, 1927; Assoc. M. Jan. 14, 1929.) (Age 36.) Deputy Mun. Engr., The British Municipal Council. Refers to H. F. Barnes, S. Eliassen, S-T. Hsu, S-T. Li, H. A. Raider, P-L. Yang.

Knapik, Edward Mathias, Assoc. M., Oakland Calif. (Elected Junior Jan. 15, 1923; Assoc. M. Oct. 1, 1926.) (Age 37.) Associated with Walter Leroy Huber, Cons. Civ. Engr., San Francisco, Calif. Refers to H. D. Dewell, B. A. Etcheverry, F. H. Fowler, J. D. Galloway, W. L. Huber, C. G. Hyde, R. J. Reed.

Leister, John Swivel, Assoc. M., Tuscaloosa, Ala. (Elected May 19, 1924.) (Age 41.) Asst. Prof. of Civ. Eng., Univ. of Alabama.

Refers to A. G. Bisset, F. H. Cooke, G. J. Davis, Jr., F. O. Dufour, E. B. Keating, F. C. Nyland, R. L. Pettigrew.

McCASHIN, CLARENCE EUGENE, Assoc. M., Chattanooga, Tenn. (Elected Jan. 18, 1926.) (Age 47.) Hydr. Engr. or Senior Hydr. Engr. (Dist. Engr.), U. S. Geological Survey. Refers to E. P. Arneson, J. A. C. Callan, C. E. Ellsworth, O. A. Faris, N. C. Grover, J. C. Hoyt, J. A. Norris, C. G. Paulsen, W. H. Sears.

MANN, RALPH HASSLER, Assoc. M., Mamaroneck, N.Y. (Elected Oct. 15, 1923.) (Age 40.) Field Engr., Service Bureau, American Wood Preservers Association, Chicago, Ill.; New York (Eastern) Representative. Refers to W. G. Atwood, W. Buehler, J. F. Coleman, D. Derickson, W. B. Gregory, J. Klorer, E. R. Needles, G. T. Seabury, H. Von Schrenk.

PEIRCE, WALTER ANDERSON, Assoc. M., Racine, Wis. (Elected Sept. 10, 1923.) (Age 47.) Mgr., Racine Water Dept. Refers to F. M. Dawson, J. L. Ferebee, R. R. Lundahl, D. W. Mead, M. W. Torkelson, C. S. Whitney.

ROSSELL, FRANCIS ALOYSIUS, Assoc. M., New York City. (Elected Oct. 15, 1923.) (Age 48.) In private practice; also Placement Mgr., PECU (part time). Refers to C. C. Armstrong, H. G. Balcom, C. E. Beam, J. Fertik, A. Lyle, R. S. Moore, O. Singstad.

FROM THE GRADE OF JUNIOR

ALOFF, ABRAHAM MARTIN, Jun., Boston, Mass. (Elected Oct. 24, 1932.) (Age 27.) Civ. Service Examiner, Div. of Civ. Service, Commomwealth of Massachusetts. Refers to C. B. Breed, E. S. Dorr, L. E. Moore, J. R. Nichols, J. P. Wentworth.

GAYA-BENEJAM, RAUL, Jun., San Juan, Puerto Rico (Elected Nov. 28, 1932.) (Age 30.) Gen. Supt. of Constr. for Puerto Rican ERA, Eng. Div. Refers to M. Font, F. Fortuno-Selles, C. A. Garcia, R. A. Gonzalez, R. Skerrett-Landron, R. M. Snell, E. Totti y Torres.

HARTMANN, ERNEST CHRISTIAN, Jun., New Kensington, Pa. (Elected July 11, 1927.) (Age 32.) Research Engr., Aluminum Co. of America. Refers to H. Cross, M. L. Enger, J. P. Growdon, S. Hardesty, T. C. Shedd, R. L. Templin, W. M. Wilson.

HICKOX, GEORGE HAROLD, Jun., Norris, Tenn. (Elected March 15, 1926.) (Age 32.) Associate Hydr. Engr., TVA, Knoxville, Tenn. Refers to B. B. Brier, B. A. Etcheverry, A. S. Fry, S. T. Harding, R. E. Hutchins, C. G. Hyde, M. P. O'Brien, N. H. Sayford, F. C. Scobey, J. E. Stewart, S. M. Woodward, D. L. Yarnell.

JAYNE, STEPHEN CORNELIUS, Jun., Wenatchee, Wash. (Elected Oct. 30, 1933.) (Age 29.) Res. Engr., Washington State Highway Dept. Refers to O. R. Elwell, C. R. Moore, C. W. Nash, H. E. Phelps, H. A. Sewell, R. K. Tiffany.

KUAN, FU CHUAN, Jun. Nanking, China. (Elected Feb. 24, 1931.) (Age 29.) Chf. Engr. of Waterways, Provincial Govt. of Kiangsu, China. Refers to F. A. Barnes, H. F. Barnes, E. N. Burrows, E. W. Schoder, F. J. Seery, P. H. Underwood, L. C. Urquhart, C. L. Walker.

McMAHON, RALPH JENNINGS, Jun., Austin, Tex. (Elected March 11, 1929.) (Age 31.) Tech. Asst., Texas State Reclamation Dept. Refers to E. C. H. Bantel, J. A. Focht, H. R. F. Helland, R. L. Lowry, Jr., W. J. Powell, A. M. Vance, E. J. von Rosenberg, P. A. Welty, B. F. Williams.

MILLER, LEROY GLICK, JUN., Elmira, N.Y. (Elected Oct. 10, 1927.) (Age 32.) Dist. Plant Chf., New York Telephone Co. Refers to E. F. Berry, G. P. Dunn, S. N. Grimm, C. S. Herrick, G. D. Holmes.

NAVE, HORACE GREELEY, Jun., Decatur, Ala. (Elected July 15, 1929.) (Age 32.) Eng. Aide, Highway Section TVA. Refers to R. B. H. Begg, D. W. Cole, J. P. Growdon, H. H. Hatch, J. B. Hays.

PHILLIPS, MARION EDGAR, Jun., Minot, N.Dak. (Elected Oct. 30, 1933.) (Age 27.) Chf. of Party, U. S. Biological Survey, Dept. of Agriculture, Washington, D.C. Refers to L. E. Conrad, F. F. Frazier, H. A. Hook, J. M. Phillips, L. V. White.

RADCLIFFE, DONALD VERNE, Jun., Long Beach, Calif. (Elected Junior March 11, 1927.) (Age 32.) Refers to V. A. Endersby, A. L. Ferver, C. Johnson, C. H. Shaw, R. D. Van Alstine, C. D. Wailes, Jr.

SNYDER, LESTER MILES, Jun., Berkeley, Calif. (Elected Oct. 14, 1929.) (Age 30.) Designer and Job Engr. with Standard Oil Co. of Cal. Refers to C. Derleth, Jr., J. M. Evans, H. H. Hall, L. W. Stocker, D. R. Warren, H. I. Wood.

SPURNEY, FELIX EMANUEL, Jun., Springfield, Mass. (Elected Nov. 26, 1923.) (Age 32.) Asst. Supt., Turner Constr. Co. Refers to F. A. Barnes, D. H. Dixon, J. P. H. Perry, R. Ridgway, W. W. Roberts, Jr., L. C. Urquhart.

TAYLOR, JAMES ELLIOTT, Jun., Post, Tex. (Elected Feb. 19, 1934.) (Age 30.) Res. Engr., Texas State Highway Dept. Refers to O. V. Adams, G. A. Field, J. H. Murdough, F. B. Ogle, G. W. Parkhill, H. N. Roberts.

YOUNG, DANA (formerly Kwai, Dana Yung), Jun., Storrs, Conn. (Elected Oct. 1, 1926.) (Age 30.) Asst. Prof. of Eng., Connecticut State Coll. Refers to C. T. Bishop, P. G. Laurson, J. W. Moffett, G. Schobinger, R. H. Suttie, C. J. Tilden, J. C. Tracy.

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Men Available

These items are from information furnished by the Engineering Societies Employment Service, with offices in Chicago, New York, and San Francisco. The service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 87 of the 1935 Year Book of the Society. To expedite publication, notices should be sent direct to the Employment Service 31 West 39th Street, New York, N.Y. Employers should address replies to the key number, care of the New York Office, unless the word Chicago or San Francisco follows the key number, when it should be sent to the office designated.

CONSTRUCTION

CONSTRUCTION, OFFICE, AND VALUATION ENGINEER; Assoc. M. Am. Soc. C.E.; age 40; B.S. in civil engineering; 15 years experience, railroad and bridge construction and valuation, railroad location, line and grade revision, bridge, trestle, and culvert construction, and reporting same as required by Interstate Commerce Commission; 11 years in responsible charge. Southeast preferred. D-4034.

CONSTRUCTION AND CIVIL ENGINEER; Assoc. Am. Soc. C.E.; Wisconsin state license; university graduate; 12 years experience on road, bridges, walls, etc.; cost reports, surveying, office work, subdivision, supervision, and inspection. Salary or location no object if there is possibility of advancement and some degree of permanency. Available immediately. C-6632.

STRUCTURAL ENGINEER AND DESIGNER; Assoc. M. Am. Soc. C.E.; 42; widower; 20 years experience in details, design, and construction, steel buildings and bridges, also reinforced concrete; plant layout and design; C.E. graduate. D-1028.

GRADUATE CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; professional engineers' license in New York State; age 35; 10 years experience covering roads and pavements, concrete bridges and electric lines. Office work on checking designs and estimates of all types of construction. Good knowledge of economics, finance, and statistics. D-3997.

CONSTRUCTION ENGINEER; Jun. Am. Soc. C.E.; 25; licensed land surveyor; now engineer inspector of water-works construction; 3 years experience, construction of bridges, grade-crossing eliminations, retaining walls, station facilities, sewers, pavements, etc. Land and topography surveys. Desires permanent connection with consulting engineer, contractor, or corporation. Available. D-2876.

EXECUTIVE

EXECUTIVE; M. Am. Soc. C.E.; consulting civil engineer; 55; married; A.B. and M.C.E.; 36 years experience; qualified for responsible supervision and management; private or public work; familiar with all types and phases of engineering activity; accustomed to handling special unique problems requiring large personnel; free for engagements. Location, West coast. A-2394.

HYDRO-ELECTRIC ENGINEER; Assoc. M. Am. Soc. C.E.; 44; single; Wisconsin state license; university graduate; total of 22 years of experience, field and office, including 5 years highway, 2 years military engineering, and 8 years (from 1923 to 1931) with consulting engineers on the design and construction of hydro-electric and steam plants. Desires hydraulic or structural design position. D-113-347-A-1 San Francisco.

GRADUATE CIVIL ENGINEERING; Assoc. M. Am. Soc. C.E.; registered in two states; 13 years experience; desirous connections; 4 years in supervision and construction of concrete highways and bridges; 5 years in charge of preliminary surveys and plans for municipal improvements; 4 years as construction engineer on large industrial plants, installation of equipment, and preliminary operations. D-1100.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; graduate of Massachusetts Institute of Technology, 1908; 25 years experience on design of steel and concrete structures and as resident engineer on construction for iron and steel industry. Thoroughly competent to direct design or to supervise construction in the field. Exceptional references. At present employed. B-5607.

CONCRETE SPECIALIST; Assoc. M. Am. Soc. C.E.; 32; 10 years experience; capable of organizing and supervising concrete-inspection and concrete-testing laboratory on large projects. Experience on special investigation and reports on concrete and the behavior of its constituents. Several papers and discussions published in technical periodicals. Excellent references. C-8022.

CIVIL AND MECHANICAL ENGINEER; M. Am. Soc. C.E.; Mem. A.S.M.E.; 44; married; graduate mechanical engineer; 24 years field and office, harbor, channel, jetty, bulkhead, and dock construction. Operation, design, and construction of all-sized dredges and marine-contracting equipment. Investigations and cost estimates. Available on short notice. D-578.